JUNE 15, 1959

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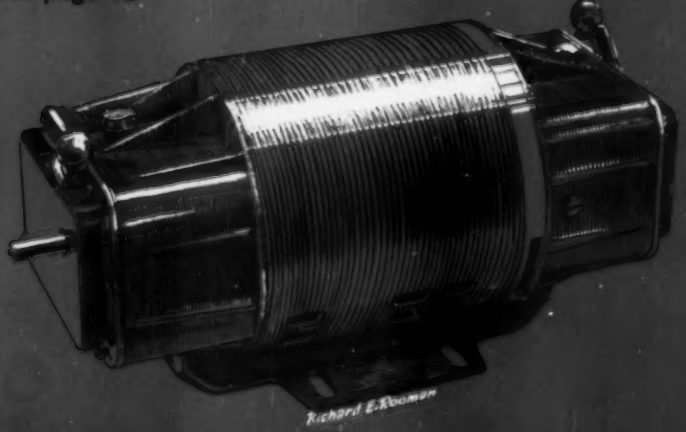
Product Engineering

McGRAW-HILL WEEKLY OF DESIGN, RESEARCH AND DEVELOPMENT

R D RESEARCH AND DEVELOPMENT news issue

AN INDUSTRIAL DESIGNER EYES THE DESIGN SHOW

see page 42



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Spectacles, pants, people, scotches, bread and butter—all these are better in pairs. So is Product Engineering, according to your comments. You like the alternating detailed Design Issue and broad-survey R & D News Issue, and so do we. Together these differing issues make a working team suited to today. With the French, we say "Viva la difference!"

But the two issues are not different in all respects. Each has "Developments to Watch," "The Engineering Week," "Horizons," "Significant Components, Materials, Processes," "New Literature," "Reader to Editor." So you get a consistent weekly distillation of the important news. Like the other pairs we mentioned initially, the two issues have points of similarity where that similarity helps you.

Read Product Engineering every week. File one or both issues. And continue to tell us what you need, what we can do to help serve all your needs.

coming next week

the DESIGN issue
for June 22

FEATURING

- **Press-fit tests solid lubricants**
  The method will help you choose among extreme-pressure candidates.

- **Gearing for higher speed ratios**
  Novel planetary system does it by pairing helical with spur gears.

- **How to lick spring tangling**
  These packaging methods will pay off—a story in photos.

- **Hidden assets in aluminum forgings**
  With smart design, this process becomes competitive.

- **Rating fluid-control valves**
  Article charts directions for simplifying such ratings.

- **Speedier PhotoStress values**
  These nomographs give values direct from polariscope.

Product Engineering

McGRAW-HILL WEEKLY OF DESIGN, RESEARCH AND DEVELOPMENT

R and D RESEARCH and DEVELOPMENT news issue

June 15, 1959 Vol. 30 No. 24

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Product Engineering ..... SIDELIGHTS

R and D Research and Development news issue

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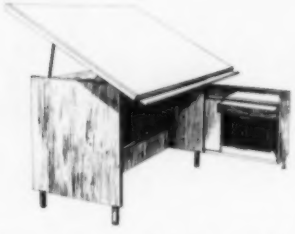

● **The Design Engineering Show** (p 42) impressed our editorial staff with, among other things, the improvement in product presentation. We were particularly intrigued by the various giveaways. Pockets bulged with nuts and bolts of various materials, with candy packaged in a ballbearing box, with pencils, calculators, plastic rulers, key rings, thimbles and miniature tools. Many lapels were graced with carnations and if anybody needed one, there was a king-size plastic shoe horn—one end for big heels, the other end for little ones. There must have been a lot of happy youngsters when dad brought home the loot.

● **Who says engineers don't have a sense of humor?** Our Los Angeles editor tells us that in the Home Products Div of Packard-Bell Inc, (manufacturers of radio, TV, and hi-fi equipment) the names on the restroom doors reflect the influence of hi-fi upon our way of life. They're labeled: "Woofers" and "Tweeters." Which is which?

● **The Auburn Mfg Co has a pamphlet** called "Engineers' Lexicon" containing 41 daffy definitions. For example: **Research**—taking credit for work done by others to prove something we've known all along; **We are making a survey**—we need more time to think of an answer; **Will advise in due course**—if we ever figure it out, we'll let you know; **a study is being made**—haven't done anything about it yet; **note and initial**—let's spread the responsibility for this; **under consideration**—never heard of it; **Under active consideration**—we are looking in the files for it.

ABP June 15, 1959

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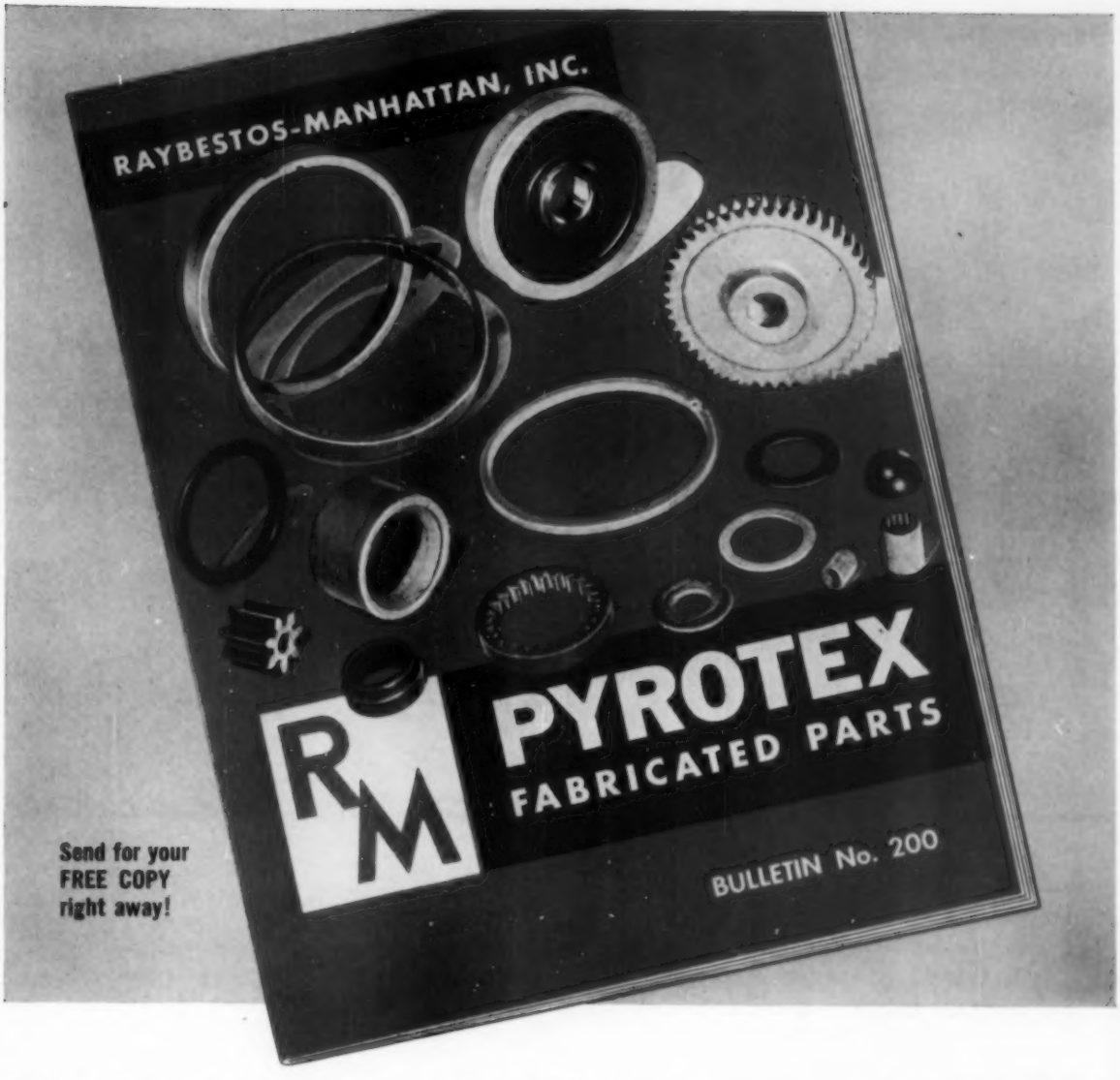

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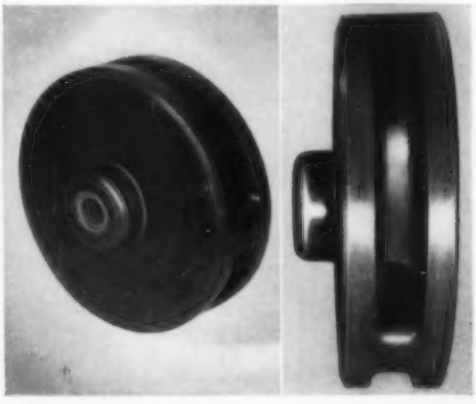
†Samples pulled @ 1"/minute (elastomer stocks normally pulled at 40"/min.)



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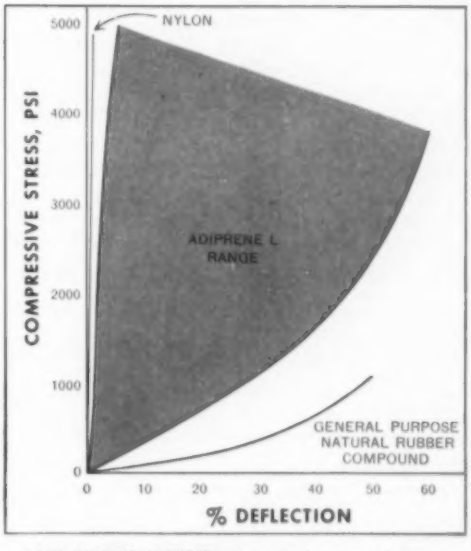

LOAD BEARING CAPACITY of hard ADIPRENE L compounds (shaded area of curve) ranges between that of general-purpose rubber and the harder plastics.

DEVELOPMENTS TO WATCH...

American

Will compression ratios rise to 17:1? . . .

. . . from the standpoint of thermal performance and brake horsepower, that's now believed to be the point of highest efficiency.

(Only 12 years ago a compression ratio of 8:1 was considered the upper limit for automobiles. Then, the average on the road was 6.7 and the top "standard engine" about 7.25:1. Today, the average is about 9.5, and engines with ratios of 25:1 are running in the labs.)

But, as W.J. Sweeney and J.F. Kung of Esso Research & Engineering told the American Petroleum Institute's Div of Refining: "If the compression ratio of spark-ignited engines is raised to any substantial extent above present levels, serious surface ignition and compression problems . . . will be encountered." These problems will call for new approaches to engine design as well as improvements in fuels. Additives will have to be developed to control starting knock, cranking difficulties, and afterrunning.

Will it be worth the effort, particularly in view of predictions of gas-turbine and solar-powered cars? Say Sweeney and Kung: "Even though the Otto-cycle engine may eventually be replaced by some other form of power plant, it appears unlikely that this will happen within the next decade. Meanwhile, the Otto-cycle engine will undoubtedly continue to be improved."

Whether the 17:1 engine will actually reach commercial production is hard to say. But J.A. Nevison, C.D. Wrigley and L.J. Test of Atlantic Refining told the World Petroleum Congress they expect 11:1 or 12:1 by 1964, with brake horsepower at 300, calling for a fuel octane rating of about 103 (research method). European cars, they predict, will be at 9:1 by then, with horsepower ratings of 80 to 100.

Fuel cells operating at 1000F, using molten-salt electrolytes . . .

. . . retained in a ceramic matrix, and hydrocarbon fuels, may prove to be the most practical choice for large-scale power generation, H.A. Liebhafsky and D.L. Douglas of General Electric's Research Laboratory told the ASME semiannual meeting. This type of power generator, attractive for its potential simplicity and thermodynamic advantages, must still be labeled "experimental" for most applications (*PE*—Feb. 7 '58, p 17 and May 4 '59, p 31). But the fact that it offers a direct route for conversion to chemical into electrical energy and can be built in almost any size is spurring research on fuels, electrode designs, and electrolytes by military as well as industrial laboratories.

In these high-temperature fuel cells, as in those operating at normal temperatures, the fuel (hydrogen or a hydrocarbon) is fed into the cell through one electrode, oxygen or air through the other. The fuel is oxidized at the anode and oxygen consumed at the cathode, causing a current to flow external to the cell.

In a cell using gas-diffusion electrodes, a molten alkali carbonate electrolyte, and producer gas as the fuel, Liebhafsky and Douglas believe fuel costs could be brought close to 3 mills/kwhr and use of methane could drop it below 2 mills/kwhr. These are, of course, only rough estimates. Much work remains to be done. But this would be progress indeed as compared to present cells which use hydrogen as a fuel, at a cost of about 14 mills/kwhr.

Growing importance of liquid metals . . .

. . . as a heat-exchange medium, as well as in fuel cells (see above) is pointed up by this portable sodium melter, built by Atomics International Div of North American Aviation. This trailer-mounted unit is specifically designed for servicing experimental sodium-graphite power reactors. But plenty of work is being done, too, on other heat-transfer applications (*PE June* 1, p 14). —ARG

Sodium metal (in barrel) is melted in two 55-gal. heaters and fed to the foil-insulated tank beneath the platform. Then, nitrogen under pressure forces it up into the filler tanks on the platform (right) from which it is transferred to the test facility.

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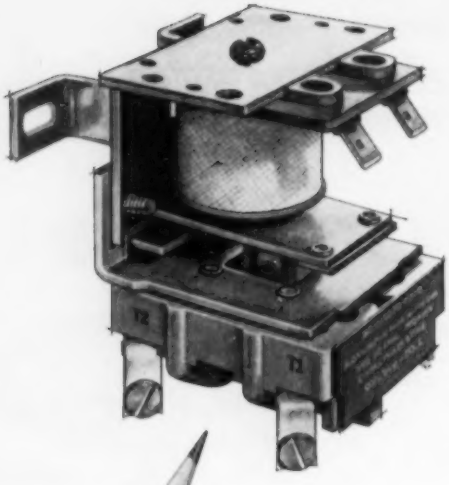

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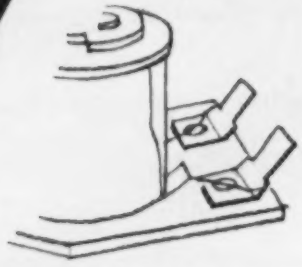

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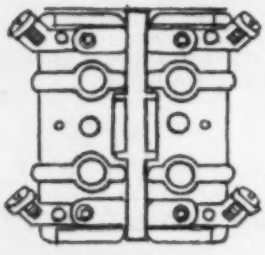

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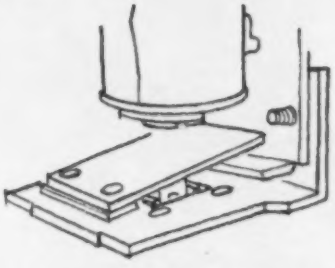

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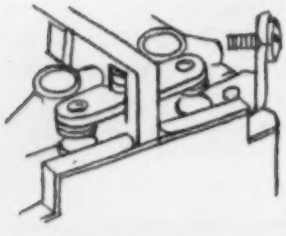

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DEVELOPMENTS TO WATCH...

World-wide

Impact strength of plastics can be increased . . .

. . . as much as 60% by adding aluminum powder to the molding mix, and other properties can be improved as well, French engineers say. The results vary with the type of plastic used; but one French plastic producer cites examples like these:

- Impact strength of polystyrene increased more than 50%, softening point raised 10 F.
- Tensile, bending, and impact strengths of phenolics all better than comparable wood-filled and fiber-filled compositions.
- Polyester resins stabilized and strengthened to the point where they can be used for pattern-making and similar applications.

In addition, as L'Aluminium Francais points out, the aluminum powder helps hold down static electricity accumulation; and, since it is priced lower than most plastics and is used in amounts from 40 to 70%, it helps reduce the cost of molded parts.

Applications now under test include washing machine agitators and galvanometer housings.

Pumps and valves instead of railroad cars . . .

. . . may be the order of the day in Canada if present plans go through. Development work on a forest-to-pulpmill pipeline system to take over from more conventional shipping networks is now well advanced, and some predict construction of such a system may begin before the end of the year. One company is already operating a pneumatic pipeline; but the new system would use water as the carrier. Canada's Pulp & Paper Institute estimates such a system could save as much as $10 a cord compared to rail transportation, but cautions there is still work to be done on loading, pumping and the like.

New centering devices . . .

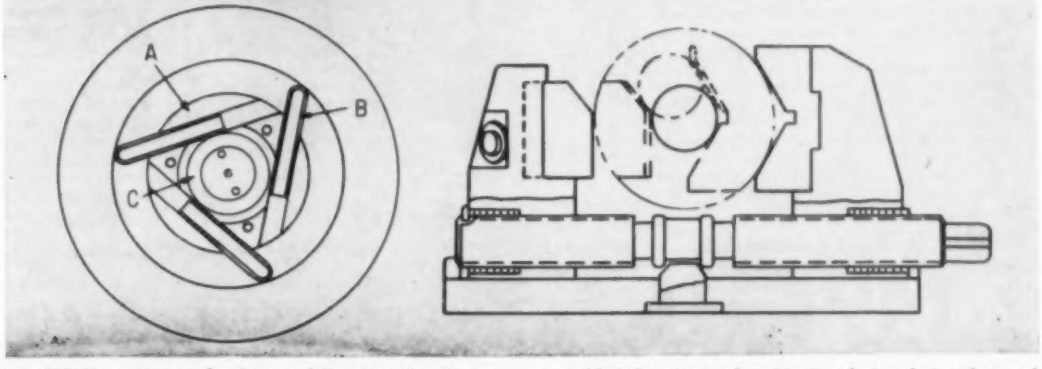
. . . are attracting attention on both sides of the Iron Curtain.

For rapid and accurate location of centerlines in machined holes, Swedish engineers have designed the "fingering" device diagrammed at lower left. It is a disk-shaped body A, fitted with fingers B which can be simultaneously extended by a toothed wheel C to "feel" the walls of the hole. When they reach adjustment, the center of the body becomes the center of the hole.

A simple change in jaw design can make vises self-centering, Soviet engineers claim. As the diagram below (right) indicates, one of the prism-shaped vise jaws is replaced by a flat one with a sloping edge that can be rotated through a small angle in the horizontal plane. The spindle of the device has different pitches on its left and right halves, chosen in a ratio which corresponds to the angle of the prism, according to the following equation, in which P represents prism angle:

$$\frac{t_{left}}{t_{right}} = \sin\frac{P}{2}$$

As one example, if $t_{left} = 5$ mm, and $t_{right} = 6$ mm, $P = 113$, which is almost equivalent to the usual angle (120°) for devices of this type. —ARG



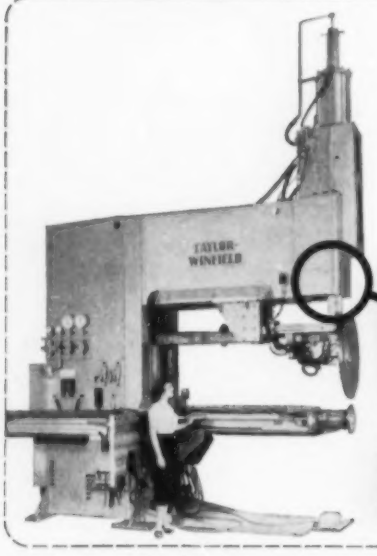
Swedish fingering mechanism and Russian vise illustrate range of hole-locating and positioning devices being designed in Europe. Swedish device (left) has "fingers," extended to meet walls of hole. Russian vise features new jaw shape.

BEARING TIPS
by McGill

McGILL *CAMROL*® bearings cost less to increase efficiency of cam follower, guide and support roller applications

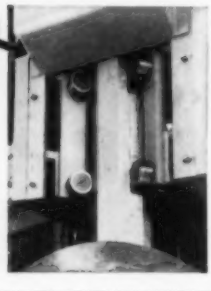
Using CAMROL CF and CYR (cam yoke roller) bearings eliminates the inconvenience of obtaining and processing component parts for built up followers. It costs less to select the proper size CAMROL bearing from stock than machine and assemble loose bolts, bushings, bearings, and snap rings.

CAMROL bearings are engineered and precision built to carry heavier loads with greater accuracy and alignment. An extra heavy outer race with full roller complement on a flanged stud (or inner for CYR) offers high load and shock capacity. Smooth, dependable action with low starting friction is assured through longer machine life. Available sealed also.



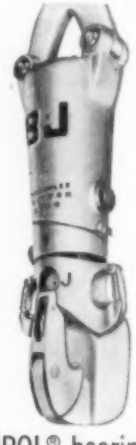
Improved performance, reduced friction and greater accuracy as ram guides in huge welder

The long ram stroke and large diameter welding wheel impose severe requirements on the CAMROL equipped ram guiding device of this resistance seam welder manufactured by the TAYLOR-WINFIELD CORPORATION.



The CAMROLS provide greater accuracy with less friction than was experienced with a round ram and bushing type bearing formerly used. Lubrication is simplified, maintenance reduced and performance is excellent.

The welder has a throat depth of 84" and a 12" vertical stroke of the upper ram carrying the large diameter welding wheel.

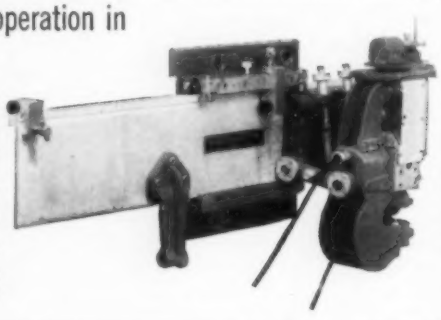


CAMROL® bearings take severe impact loads in hydraulic snubbing hooks

CAMROL CF bearings are used as hook positioner rollers in BYRON JACKSON HYDRAPLEX HOOKS. These heavy-duty (500 ton capacities) hooks are used in oil well drilling work. The hook positioner mechanism includes CAMROL cam followers that travel on a hardened cam track when the load is released to return the hook to its original position. The CAMROL bearings take severe impact loads in the thousands of pounds.

Ease of assembly and smooth operation in electrolimit continuous gage

PRATT & WHITNEY CO., INC., manufacturers of the ELECTROLIMIT CONTINUOUS GAGE shown here have cut costs through the elimination of built up followers requiring ball bearings, shafts, spacers and milling slots by using sealed CAMROL bearings. They are prelubricated and protected. The CAMROL bearings which travel along a vertical cross slide rail, provide smooth, easy action as the gage slides onto strip material running through the mill. No bearing replacement reported in over 10 years.



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DEVELOPMENTS TO WATCH...

Washington

Planes to fit airports . . .

Federal Aviation Agency officials have issued no formal edicts but quietly they're drafting plans to reverse a trend—they believe that aircraft must be built to fit existing airports, and not the other way around.

The agency's chief, Gen Quesada, has already ordered a full-scale program of investigation to unearth technical developments which can be applied to aircraft now in production. The agency is urging manufacturers to design these developments into planes: particularly those that permit shorter take-off capability.

The jet airliner as first designed was perfectly suited to existing airports but airline management felt it necessary to pressure manufacturers to build bigger and bigger planes for increased payload. Now airliners have outgrown the airports. Extensions are being made at existing airports and as a result, FAA officials report, airport operational budgets are skyrocketing.

Agency officials intend to put a stop to this. They are going to refuse to give federal aid for runways that go longer than 10,500 ft or thereabouts. They will even pressure manufacturers, using the weapon of certification, to keep the size of planes down, to require higher-horsepower engines, to equip planes with assists that will permit flying in and out of present-sized fields.

The present Boeing jets, with added power from the 16,000-lb thrust engines, perform better than the first, smaller, and lower-powered 707.

Also, future supersonic jet transports are expected to be so well-designed that they will not require longer runways.

A national registration of engineers . . .

may be taken on by the National Science Foundation. It already maintains a register of scientists, but up to now has only made a token effort at listing the estimated 700,000 or so engineers spread across the nation.

The foundation asked Congress for $1-million in funds to run its register and scientific manpower studies for fiscal 1960. The House of Representatives cut this by some $140,000. But there is still a chance that the Senate will restore the funds.

Next February, the foundation plans to start sending out new questionnaires to scientists to bring their register up to date. It has collected data on about 175,000 scientists of an estimated 300,000.

NASA reactor critical soon . . .

The National Aeronautics and Space Administration plans to start operating its Plum Brook, Ohio, nuclear reactor this fall to study nuclear propulsion systems, both for aircraft and rockets.

The agency is confident, too, that Congress will okay the $5-million it has requested to build a large-scale rocket-propulsion research center. Congress has balked at the project because the agency had not selected a site for the facility. Now, NASA is saying that it seems sure to get the money.

First US demonstration plant . . .

for conservion of sea water to fresh will be located on the Gulf Coast, according to Interior Secretary Fred Seaton. An official announcement will be made soon. Chances are that Texas will be the choice because it has indicated it is willing to put up some research money; California may be next.

A technical introduction to space . . .

has been printed by the National Aeronautics and Space Administration under the title "the challenge of space exploration."

The 48-page booklet—available by writing the agency at Washington 25, DC—gives a clean, easy-to-read, simply illustrated short course in the space environment and the engineering problems in the devising of machines to probe space and navigate to a planet and return.

There's a chapter on rockets, engines, and propellant of all kinds—up to and including a simplified diagram of an ion rocket. There are schematics of space ships and even tables giving the engineering requirements for a Mars round trip.

WHAT'S HAPPENING IN... Materials

More data on exotic metals

For engineers exploring possible applications of such metals as molybdenum, columbium, zirconium, vanadium, and thorium, suppliers are offering a variety of helpful leaflets, plus down-to-earth pricing information.

From Universal Cyclops, for instance, comes a molybdenum and molybdenum-titanium alloy pricing schedule that's impressive in its completeness, gives data on bar, sheet, and foil in a wide range of sizes. (Prices are impressive, too—they're all in dollars per lb—and most in the $12 to $30 range).

An 8-p leaflet from Metals & Controls provides a brief descriptive outline of half a dozen nuclear metals, including those mentioned above, and indicates forms available though it gives no specific data. Also available from M&C, a one-page sheet on uranium and thorium foils.

Also worth noting: the roundup on corrosion resistance of Ta, Cb, Zr, Ti, Mo, and W which appears in Fansteel Metallurgical's *Corrosionomics*. It points up once again the fact that even the most "corrosion-resistant" material has its Achilles heel–and some of those whose over-all performance is far from perfect may yet be best for specific applications.

(Note: for more on exotic metals, see *PE—Mar 17 '58, p 66.*)

Fabric secrets the fibers don't tell

Using charts of fiber properties to predict performance of structural fabrics can be misleading if not outright dangerous, Navy studies indicate.

The Naval Air Materiel Center has been investigating a variety of fabrics for airship construction, and has turned up a number of facts of interest to users of fabric laminates, diaphragms, and other structural parts. In airships, cotton has been the standard material of construction. But it has several drawbacks. Navy has therefore been testing several synthetics; among them, nylon, Dacron, Fortisan and glass fibers.

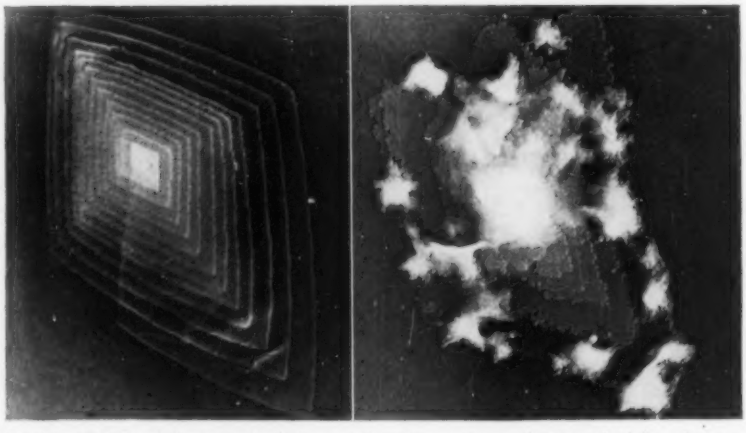
As W T Kelly of the Aeronautical Materials Laboratory told a recent ONR symposium, under normal conditions, on a strength-weight basis, any one of these should be suitable for airship use. Cotton's strength is rated at 3 to 4 gm/denier; while glass, Dacron and Fortisan are 6 to 7 gm/denier; and nylon's strength is about 7 to 8 gm/denier. When the fibers are wet, though, the picture changes, particularly at elevated temperatures. Cotton, nylon, Fortisan, and glass fabrics are all significantly affected by moisture. Dacron is not. When wet, cotton loses 10 to 30% of its strength; nylon loses about 10%; Fortisan and glass about 15%.

Theoretically, heat—at temperatures below 200 F—should have little or no effect on any of these fibers, wet or dry. The fact is, though, that temperatures even as low as 140 F can cause temporary softening of laminated synthetic fibers, with a resultant loss of strength and adhesion that may approach 50%. This effect is easily overlooked because the laminate may recover its strength on being returned to room temperature.

In elongation, too, the synthetics pose certain problems. At ultimate tensile strength, cotton, Fortisan, and glass are about equal in elongation: 7%. High-tenacity Dacron shows about 13%; nylon, 18 to 23%. But Dacron stress-strain curves indicate that most of the elongation occurs *after* 85% of the ultimate load has been applied; while the others elongate gradually over the full range. Dacron will actually elongate less than the others in most applications.

These are only a few examples of the considerations which enter into selection of a particular fabric for structural use; but they do demonstrate the need for realistic testing—and a lot more research. —ARG

New plastics: photos show why they're different



Single crystals of linear polyethylene and polypropylene, photographed by electron microscope at American Viscose Corp's Research & Development Div, show the structural differences that give these two new materials their unusual properties. As the picture at the left shows, linear polyethylene fully justifies its name. Its ordered lamellar structure permits sliding of one flake on the next, makes the material easy to form. But polypropylene (right), has an isotactic structure *(PE—Aug 11 '58, p 12)* that reduces freedom of movement and accounts for this plastic's greater rigidity.

STRENGTH AND UNIFORMITY are outstanding characteristics of the automotive ball-joint bearings shown below. These sintered metal parts demonstrate Moraine Products' capabilities in working with customers to develop the most practical designs. They also demonstrate Moraine Products' responsibilities—making economically, and in quantity, parts that must not fail under the most rugged operating conditions.

Parts shown ½ actual size.

Vital parts for industrial progress

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Division of General Motors, Dayton, Ohio

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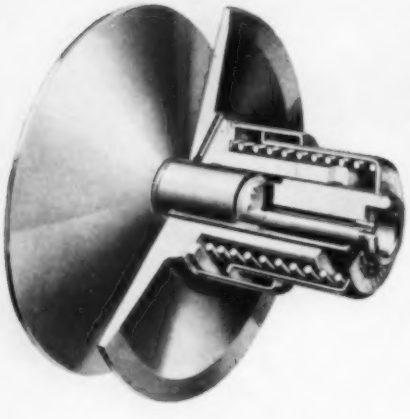
MULTI-PITCH SHEAVES. By adjusting movable flanges, you can provide larger or smaller pitch diameters on these multi-pitch sheaves. The adjustment can be made either when stationary (Stationary Control) or when in motion (Motion Control). They have a speed variation up to 2 to 1 on drives of from 1 to 600 hp. Motor bases are available to compensate for changes in center distances.

SPEED VARIATION **2:1**



MOTOR PULLEY DRIVES. Worthington's new variable motor-pulley drives combine the efficient power transmission of a V to V drive with the industry's simplest motor-pulley designs for dependable low-cost power transmission with maximum hp. capacities. Ratios 3 to 1 hp. ratings ⅛ to 15. Angle-Matic motor base automatically maintains belt alignment and allows use of true V-groove companion sheave.

3:1

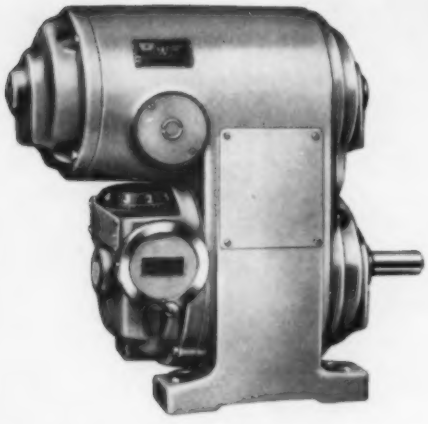
SOMEWHERE ON THIS LINE

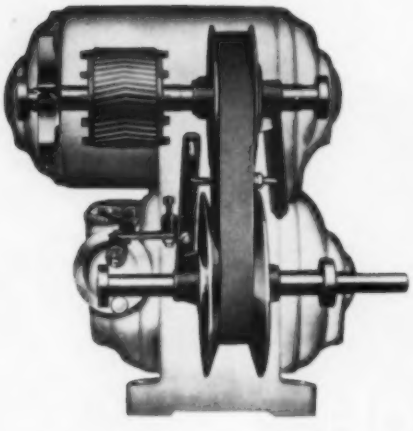
YOU'LL FIND THE ANSWER TO YOUR

Sound V-belt engineering practice was used throughout Worthington's line of mechanical variable speed drives. They feature compact design, accurate speed control and long belt life.

The line consists of multi-pitch sheaves, motor pulley drives, motor drives, and allspeed drives which handle speed variations up to 20 to 1 and horsepowers from ⅛ to 600.

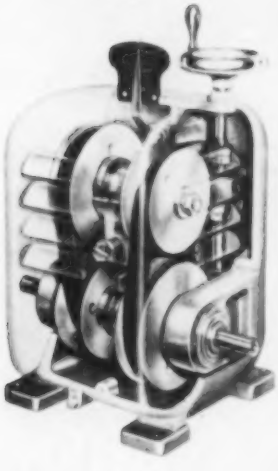
COMPANION SHEAVES AND VARIABLE SPEED BELTS are available from Worthington for use with multi-pitch sheaves and motor pulleys. All companion sheaves are equipped with the famous QD hub with the "Golden Screws." Oil-resistant, static-dissipating construction is standard for all Worthington variable speed belts.





MOTOR DRIVES. Positive pulley adjustment provides accurate speed control. Once you set the speed, the pulley holds it, regardless of varying load. Other benefits include: belt tension in proportion to load, giving extended belt life; compact design and transmission of full rated horsepower. Available in ratings from ½ through 25 hp. with speed variations up to 10:1.

10:1



ALLSPEED DRIVES. Not one, but two belts are used, resulting in an extremely compact unit. This "Twin-V-Tandem" design also gives a very wide speed variation (up to 20:1). Because of positive pulley adjustment, speed control is very accurate. Available in ratings from ⅓ through 5 hp.

20:1

VARIABLE SPEED PROBLEM

For more information about Worthington's complete line of variable speed drives, get in touch with your nearest Worthington representative or distributor. Or mail the coupon at right.

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- ☐ Motor Pulley Drives (1 to 15 hp.)
- ☐ Motor Pulley Drives (FHP)
- ☐ Motor Drives
- ☐ Allspeed Drives
- ☐ Variable Speed V-Belts

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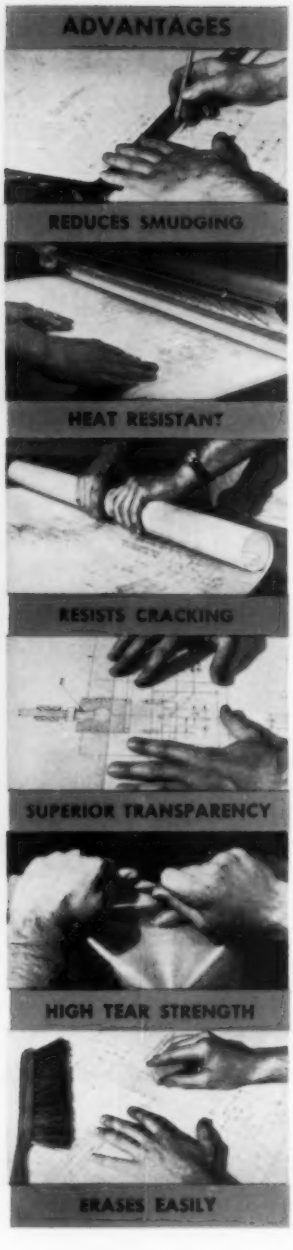

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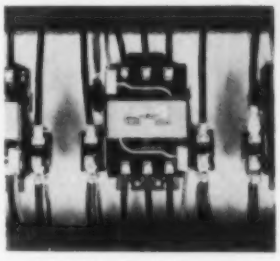
SAVE PANEL SPACE—General Electric Size 2 starter features front-accessible wiring, coil, contacts and overload relays, eliminating the "extra" panel space often required for these operations. Lower coil watts give less heat, and coil inrush current has been reduced so you can use a 33% smaller control transformer.

SAVE ASSEMBLY TIME—This 55% lighter-weight starter is fast and simple to install. Straight-through wiring eliminates run-around wiring that takes extra time and space. To mount, just slide the keyholes over three mounting screws on the panel. You'll easily save assembly time.

GREATER DEPENDABILITY—Exclusive General Electric wedge-action contacts provide



positive "make." Less armature mass and spring-loaded contacts practically eliminate contact bounce, provide longer contact life. A new arc trap design attracts arcs away from contacts and dissipates both arc and ionized gases.

EASY MAINTENANCE—Like the rest of General Electric's 100-Line magnetic starters, the Size 2 can be disassembled in 20 seconds, and contacts can be visually inspected in ten seconds. Your customers get simplified maintenance.

LIKE MORE INFORMATION? Contact your nearby General Electric Apparatus Sales Office, or write Sect. 731-16, General Electric, Schenectady 5, N.Y.

GENERAL ELECTRIC

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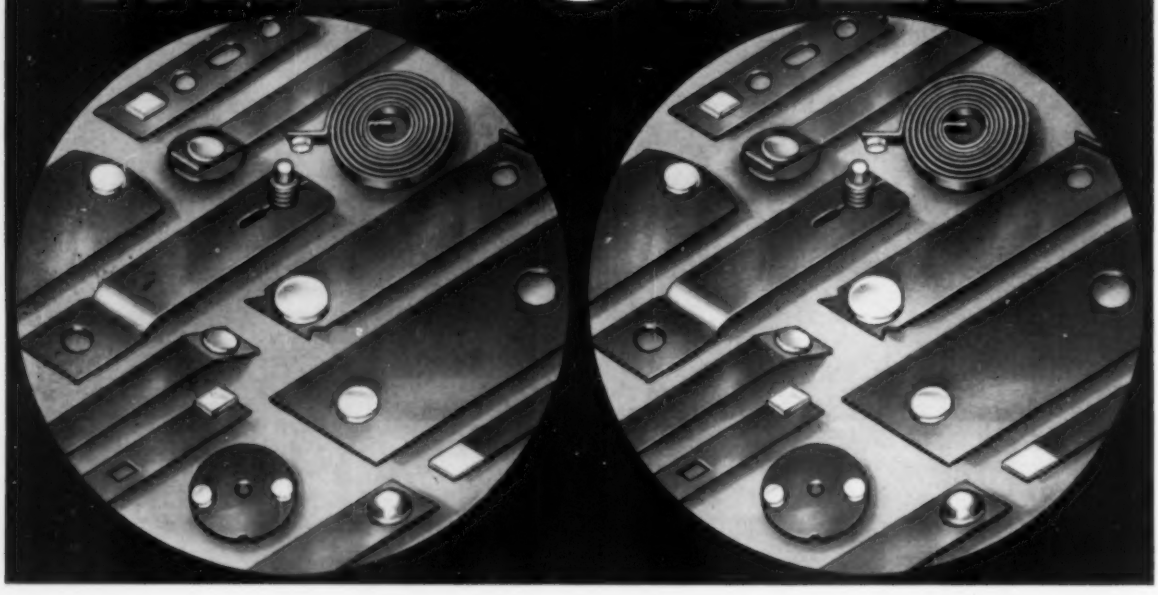

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Product Engineering

HORIZONS

June 15, 1959

the real FRANKENSTEIN

A recent science-fiction story describes a bulldozing operation which inadvertently opened a millenia-old tomb on a faraway island. This released a vengeful "something" from outer space that had the power to enter metal—so the bulldozer turned on its driver and other humans. Quite a lurid story . . . in which humanity was saved only because the last few humans worked out a way of fusing the "something" with a welding generator.

This theme, which appears frequently in the popular press, is by no means new. There are the legend of the fisherman and the genie, Aladdin's lamp, the story of the magician's apprentice and the water-bringing animated broom, the more-modern Frankenstein, even the children's stories of animated cabooses, chairs, houses. There may, of course, be some force from outer space that will show abilities beyond our ken, perhaps almost as great and diverse as those attributed to the crews of flying saucers. But the possibility that an earth-made automation will turn on its creator, showing greater intelligence or ingenuity is ridiculous.

But Dr Norbert Wiener, to whom we are indebted for the word "cybernetics" and associated methods of study, apparently doesn't think so. Speaking before a philosophical meeting in New York recently, the noted MIT mathematician suggested that men may be building automata which have unexpected powers—the ability for originality akin to that of the human brain.

But to leap from there to the statement that the "robot brain can destroy its creators and users" is a vast leap indeed. Come, come, Dr Wiener!

Perhaps Dr Wiener had in mind only the fact that an automatic factory can be conceived and constructed to overproduce a particular item and thus create unemployment, or that an automatic computer can arrive at an answer that is incorrect and thus cause disaster. But these potentials are not the responsibility of the machine but of the man who programs it.

Others at the meeting recognized this. They pointed out that there are important differences between man's consciousness and that of the literal-minded automaton. (Dr Wiener countered by saying he's not sure how to define consciousness.) And they also said what is basic in the whole problem—that likening an automatic machine to the human brain is just plain cockeyed.

Here may be the real Frankenstein—man's willingness to believe the myth he has created that a machine can think or originate. The human brain is not a machine, nor does it operate like one. And there are other factors in the human makeup . . . call them consciousness, soul, humanity, or what you will . . . contributing to our actions that no Frankensteinian monster could ever have. It is time that we remember that Frankenstein was the man, not his monster—and it is man himself who is man's greatest potential danger.

K. D. Tarpenning

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Seek to Reduce Weapon Design Obsolescence

WASHINGTON—A furor over the Pentagon's continental air defense program underscores the basic paradox in military design engineering: the rapid obsolescence of weapons in production which are about to become operational after long years of R & D.

At issue in the air defense controversy are two surface-to-air missiles: The Army's Nike-Hercules (major contractors are Western Electric, Douglas Aircraft, Thiokol Chemical) and the Air Force's Bomarc (Boeing Airplane, Westinghouse, and Marquardt).

Under present Defense Dept planning, both missiles are in quantity production and both are being deployed for operational use. But, prodded by Congress, the Pentagon is being forced to reappraise air defense strategy.

The lawmakers are agitated by charges that the two missiles will perform duplicating tasks. Even more significantly, they are impressed by arguments that further expansion of the present air defense system would be wasteful. The critics' argument is this: that present defenses provide marginal protection since they are geared only against an attack by manned bombers at a time when the ballistic missile poses the real threat.

The upshot of the Pentagon's new look at air defense seems sure to be a halt at Nike-Hercules base construction. Production of the missile will continue at a drastically reduced rate to equip bases already built and for overseas deployment. The Bomarc program will be scaled down too.

In recent weeks Congress has brought the long-simmering issue to a climax. The Senate Armed Services Committee ordered the Army not to build any new Nike-Hercules bases. Funds to build at least 25 more installations were already on the Army's books. Then the House Appropriations Committee slashed almost one-third the Air Force's budget request for Bomarc procurement.

Actually from the standpoint of design and performance objectives the Nike-Hercules and Bomarc are not competing missiles:

- Nike-Hercules is powered by a solid-propellant rocket, has a range from 50 to 100 miles, and is guided by a radar command system. It is supported by elaborate group control apparatus at each base—a computer, radar to detect and track the target, and a third radar to track the missile itself and report the missile's movement to the computer.
- Bomarc is launched by a liquid-propellant rocket, is powered in flight by twin ramjet engines, has a range of roughly 200 miles, and is guided by a radar homing system. It is essentially a pilotless interceptor, steering itself toward the target after launching by means of a self-contained mechanism activated by the target.

That the Pentagon wants to reduce such obsolescence is indicated by the following Washington report: Although a full-scale engine has been successfully fired for the Nike-Zeus anti-missile missile, the DOD refuses to speed the weapon into production. It wants to test and develop further. Unlike Nike-Hercules vs Bomarc, Nike-Zeus has no competition in the anti-missile field, but the Army is taking no chances, doesn't want a better one to suddenly appear.

Static firing of the Nike-Zeus engine was achieved through use of a highly efficient motor case with thin walls, special high-energy fuels, and a high-heat-resistant nozzle.

Booster engine, used during early stages of flight, was fired last year while the sustainer engine, used during later phases, was static-fired more recently.

The competition between the two missiles results primarily from the tough hold-down on the defense budget—the Army and Air Force are both competing for larger chunks.

The competition also reflects a basic difference in air defense philosophy—the Army with its anti-aircraft artillery tradition views the shorter-range point defense concept as the stronger; the Air Force is skeptical about what it calls "last ditch" defense near the target and seeks interception and destruction of enemy aircraft much earlier.

Behind the current fuss about these fundamental factors: both missiles

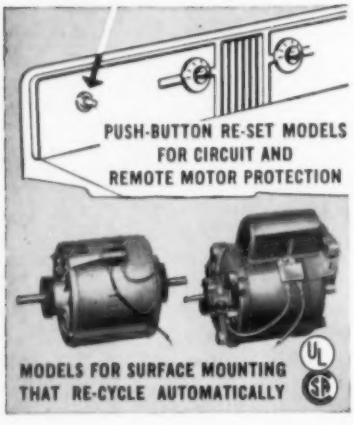
Wheelless Ford Slides on Air

First full-scale, wheelless air-propelled vehicle is demonstrated by Ford Motor engineering executives at Dearborn, Mich. Compressed air emitted through small holes in three levapads on upper side of vehicle contributes to frictionless ride—Levacar Mach I slides on a film of air a fraction of an inch above ground. All-aluminum car weighs 450 lb, 95 in. long, 48 in. high, 54 in. wide. Three levapads are 7 in. in dia, and require 50 lb of air pressure per sq. in. Next step may be building of 6- to 8-passenger vehicle to operate at 200 mph on rails. Curtiss-Wright Corp is currently marketing a modified version of a wheelless, air-propelled vehicle, called the Air-Car, utilizing same principles as Ford's Levacar Mach 1.

Protect your motors and circuits with

MP MINI-BREAKER®

17 appliance makers say it really cuts service problems, **adds sales spark**



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MECHANICAL PRODUCTS, Inc.
1824 RIVER ST., JACKSON, MICH.

were conceived years ago when the manned bomber threat was at its height. But design studies, prototype testing, and other phases of development dragged on for so many years that when the two weapon systems finally neared the operational stage, the bomber threat had been replaced by the new danger of ballistic missiles.

The Nike project was started in 1945. Initial firing tests began about 18 months later and the first battery was set up ready for action in December 1953. This was the Nike-Ajax model which has a range of about 25 miles. There are roughly 200 such installations spotted around the country now—many of them being converted for the more advanced Hercules on which research started in 1953.

The first Hercules test firing took place in January 1955. The missile became operational in June 1958.

Bomarc has an equally long history. The first production contract was awarded in May 1957 after about 12 years of designwork on a pilotless interceptor. The first Bomarc units are scheduled to be ready for action later this year.

You get the expected explanations of the extended development lead time for the Bomarc and Nike missiles from the two parties concerned. Pentagon bureaucrats contend the project scientists and engineers went overboard with their claims of what the respective missiles could do, that original missile designs could not easily be translated into engineered products.

The project officers, on the other hand, complain of budget restrictions and—even more important—serious and continual delays in the Pentagon's decision-making machinery at crucial periods in the projects.

After all the pulling and hauling, of course, the anti-aircraft missile defense system will not be scrapped. Military experts still see a threat of attack by manned bombers for at least three more years.

"Our B-52 bombers will be around for some years to come," says one top-level Pentagon man, "even while we bring ICBMs into our inventory. There's no reason to believe the Russians won't also keep their long-range bombers. And we're not going to make the enemy's job easier by tearing apart our bomber defenses," he concluded.
—Mort Reichek

Conclave Spotlights Solar-energy Potentials

NEW YORK—Solar furnaces are a powerful research tool and will play an important role in understanding the behavior of materials at high temperatures. This potential for solar heat was predicted here at the Solar Energy Symposium in which 150 scientists and engineers considered applications and design of such furnaces. The conclave was sponsored by New York University, Stanford Research Institute and the Association for Applied Solar Energy.

As a research tool the solar furnace

Largest US Solar furnace . . . .
is this Army Quartermaster unit at Natick, Mass. Heliostat (right) passes sun rays to concentrator (left) through control vanes of the attenuator (center). The concentrator converges ordinary sunlight into 4-in. circle within the test chamber where thermal-protective materials are under study.

has two major advantages, Dr T. S. Laszlo of Avco Research and Development pointed out. It is a source of intense heat for extended periods and permits experiments in precisely controlled atmospheres. On the negative side, it heats only one side of the material under investigation, produces a very small hot zone—usually only 1 cm dia—and must depend on the unpredictable sun.

QM BUILDS BIGGEST

Another speaker, E. S. Cotton, of the Quartermaster Research and Development Center in Natick, Mass, described the record-size solar furnace the Quartermaster Corps built and is presently testing. The unit has a 4-in. thermal area and produces heat intensity of 60 cal/cm² sec. Shutdowns have resulted primarily from weather, but also for repairs and realignment of mirrors. About 5 to 10% of the time that the unit was down for weather, high winds were the cause. Such losses from wind call for design of a damping mechanism for the heliostat to stabilize the unit when the wind blows 12 knots or better, said Mr Cotton.

The heliostat and concentrating units of the Natick installation are made of many small mirrors, rather than a single large one. These mirrors measure 2 by 2 ft. The heliostat contains 355 panes; the concentrator, 180. For the flat heliostat panes, ¼-in. plate glass is lined with copper plate and enamel. The slightly concave collector mirrors are set in aluminum. The heliostat tracks the sun with a photocell imaging device having feedback to a motor drive.

Dr. W. M. Conn, a consulting physicist from Kansas City, reported that the solar furnace at Montlouis, France is presently being used to produce zirconium oxide powder and certain other materials.

SOLAR DESIGN PATTERN

One problem in designing a solar furnace, according to Paul Jose of the Holloman Missile Development Center in New Mexico, is that the sun is not a uniform radiating body—that is, it radiates more intensely from its center than from the edges. And distribution of energy at the hot spot of the furnace will have the same pattern.

Engineering specifications for the

(Continued on page 26)

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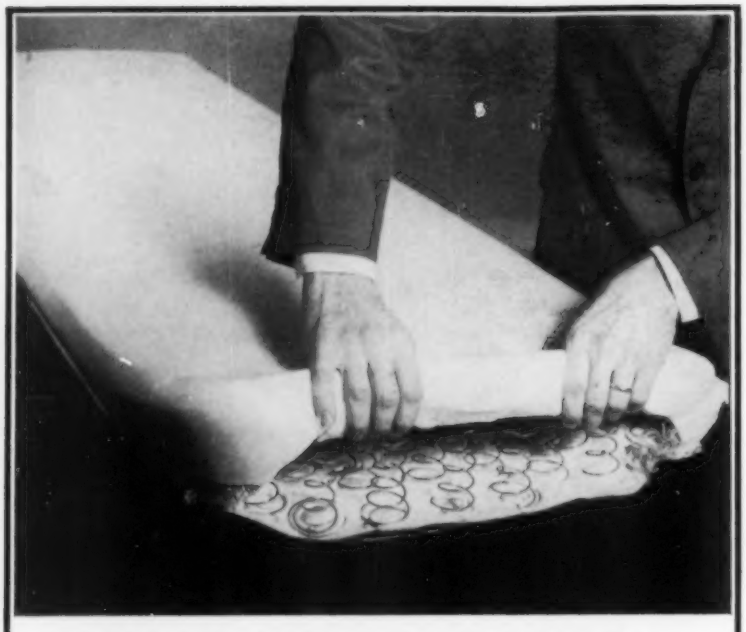

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DIVISION OF STUBNITZ GREENE CORP.

Holloman installation required that the heliostat could deflect no more than 2 mm. of arc. This strict limitation caused a difficult design problem for the 150-ft high structure, Jose added. He also said that mirrors at Holloman will be backed by Styrofoam for a 50 to 60-ton reduction in structural weight. ■

New Deal for Hungarian Inventors

VIENNA, AUSTRIA—A new Hungarian government decree provides for the systematic utilization of inventions by considering the introduction of methods already used in other branches of industry as innovations.

The innovator will receive a remuneration of 7 to 10% of the annual economic profit achieved by the innovation. In contrast to present practice, the bonus is paid at the time of introduction; not at the conclusion of the contract.

According to a government spokesman, it will be in the interest of the innovator to help with the introduction. The new decree fixes the upper limit of the collaborators' bonus at 100%, instead of the present 50%, and the lower limit at 10%. Thus, persons who collaborate with the innovator can be remunerated according to their contribution. ■

New Science Adviser Is A Scientist

WASHINGTON—The President's new science adviser, Dr George Bogdan Kistiakowsky, has a completely different set of talents than those of the recently retired Dr James R. Killian, Jr. The 58-year-old Russian-born Harvard chemistry professor is highly regarded as a research scientist but relatively inexperienced and unknown in public life.

Dr Kistiakowsky is best known for his work on the kinetics of chemical reactions; he helped assemble the first atomic bomb. He served on the 3-man delegation to the Geneva talks on ways to avoid surprise attack and has been a member of the President's advisory committee from the beginning.

Dr. Killian, an administrator and not a scientist, has been criticized pri-

vately in the scientific community for making important scientific decisions that purportedly were over his head. Killian's direct influence on the President was seen in decisions not to build a nuclear-powered airplane, to conduct the Project Argus atomic tests in space, and to build both Jupiter and Thor ballistic missiles. Dr Kistiakowsky may have different opinions on such matters. ■

Transistor Diodes May Improve Design

LONDON—Transistor diodes, tiny 'circuits within themselves' which outperform their conventional transistor counterparts, are spearheading an important new advance in electronics, William Shockley, president of Shockley Transistor Corp, declared in the opening lecture of the International Convention on Transistors and Associated Semiconductor Products here.

Four-layer transistor diodes, the first commercially available examples of solid-state circuitry, are based on "new principles of transistor operation which permit internal control action in place of the external control required for conventional transistors," he said. Because of this simplification, he added transistor diodes require only two wire connections instead of the three used by transistors. Whereas some circuits previously required two or more transistors as well as other components and connections, this is now done within a single silicon chip smaller than a typewritten period on a piece of paper. Space and weight economics that result will increase applications of these diodes to household electrical appliances, computers and missile systems.

Recent experiments indicate that within two to three years transistor diodes will attain power levels from 10 to 100 times higher than related transistors with comparable frequencies and efficiencies, Dr Shockley predicted.

In terms of future development, the engineer continued, calculations show that four-layer transistor diodes used in class C oscillator and amplifier circuits can be operated at high power levels over junction areas much larger than are possible for transistors.

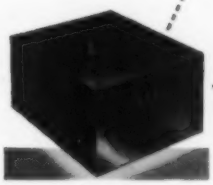
To obtain this uniform operation over large areas, he revealed, two new operating principles are employed. The

(Continued on page 28)

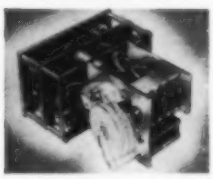
The NEW Series BH100

MILLI-V-METER*

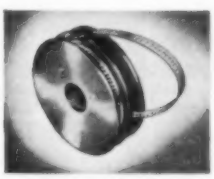
DIGITAL READOUT



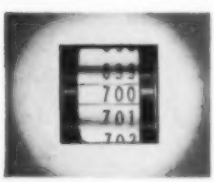
SMALL SIZE — This compact, transistorized, servo-driven instrument measures only 3 x 5 x 5¾".



ALL INCLUSIVE — With Zener reference, power supply, amplifier, servo motor, 144" tape-slidewire.



TAPE-SLIDEWIRE — Mounted on side-by-side spools, slidewire is embedded in edge of tape, punched for sprocket drive.



PRINTED READOUT—Calibration printed on tape available to measure steady-state conditions or where input deviates more than 13%.

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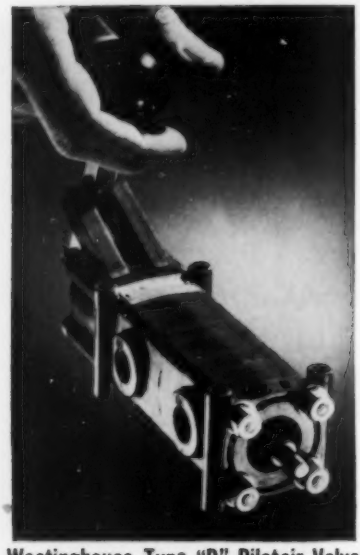

Westinghouse Type "D" Pilotair Valve

Another of Westinghouse Air Brake's many AIR CIRCUITRY components, the "D" PILOTAIR® Valve is a spool-type directional valve that can be operated by a lever, button, cam, solenoid, air pilot, pedal or treadle. Valves available in two, three, and four-way operation, two and three position, open neutral, lap neutral and vented neutral. Port sizes are ¼" and ½" ips. Operators may be on either or both ends. Max. operating pressure: 250 psi.

DESIGN FEATURES. A new design of seal and segment construction gives the "D" PILOTAIR® Valve increased capacity and requires a minimum of maintenance. By rotating operators, their mounting brackets and any of their ports in 90° steps, over one-hundred thousand combinations may be obtained. They operate in any position with air, gas, water and most oils. The "D" PILOTAIR® Valve can satisfy any of your directional valve needs. For more information, ask for catalogue A4-75.01.

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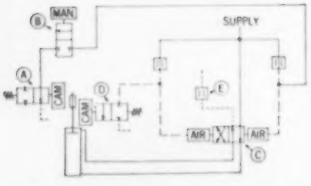
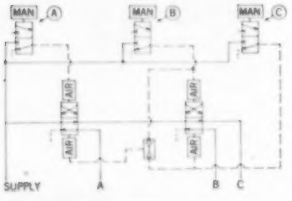
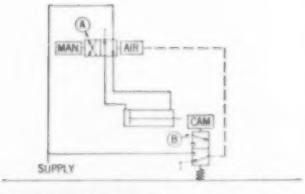
This is the Westinghouse term for application of pneumatic control systems to industrial production operations. Safe, economical, precise Air Circuitry is now being used to solve the most rigorous and complex control problems in industry. Westinghouse Air Brake has pioneered the application and development of air control for more than 80 years. Today our engineers can design an air circuit which will boost production and cut costs.



1. AUTOMATIC CYCLING—Supply air flows to the cylinder to extend the cylinder rod and actuate cam operated valve "A." By operating valve "B" air is bled from the right-hand air pilot of valve "C" to operate this device and retract the cylinder rod. This actuates valve "D" and reverses the process. Cycling time may be changed by regulating the FLOREG® valve "E." The stroke is set by moving the cams on the cylinder rod.



2. STATION TRANSFER—Any of the three stations may capture supply air for the station by operating its respective valve. This may be expanded to any number of stations.



3. AUTOMATIC RESET—To reset the operating valve "A" after completion of an operation. Moving the manual operator admits supply air to the cylinder to extend its rod. At the end of the cylinder rod stroke cam operator valve "B" is actuated to connect supply air to the air pilot operator of valve "A." This returns this valve to its original position. Supply air is then connected to the cylinder to retract the cylinder rod. The circuit is now ready for recycling.

See the Yellow Pages under Cylinders for the Name of Your Local Distributor

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first is impulsive charging by which the interior base layers are uniformly flooded over their entire areas with electrons which turn the diode on like a switch. The second is majority carrier extraction which removes the added electrons as well as some that are normally present. This turns the diode off like opening a switch and leaves it in an optimum condition for impulsive charging. Preliminary experimental results are in keeping with the theory, he concluded. ■

Two-layer Chromium Holds Down Corrosion

DETROIT—Results of recent corrosion tests indicate that thicker chromium, properly applied, is one of the least-expensive methods of achieving greater durability. In addition to work by Metal & Thermit Corp, independent studies at Battelle Memorial Institute sponsored by the American Zinc Institute have concluded that "increasing the thickness of copper and nickel is less effective in preventing corrosion than increasing the thickness of chromium."

DUPLEX CHROMIUM PROCESS

This led Metal & Thermit to research a duplex chromium process. Process consists of an initial application of bright, crack-free chromium for optimum coverage and buildup in low current-density areas, followed by a second bright deposit of finely cracked chromium from a specially operated bath. Only addition to present equipment is one tank.

The initial coating goes on in five min., about the time required in a single-plate process, and the second coating adds another five min. However, the duplex process multiplies chromium consumption by a factor of 5.

INDUSTRY FACING PROBLEM

A reason for the duplex process is pressure by the public on the automotive industry. Chrome has continued to rust at an alarming rate, and the car buyer is demanding better chrome plating.

The automotive industry is setting higher performance standards for exterior plated parts. This is borne out by the new severe accelerated corrosion tests developed by the industry in cooperation with AES and ASTM.

A high-volume part such as a bumper for a Ford will cost about 7¢ more to plate with the new procedure, including taxes, labor, equipment, etc, says a spokesman. For all brightwork, cost increases range from 20¢ to $1.50 per car, depending upon volume and area involved. However, M&T claims that these increases are sharply reduced and in some instances, eliminated, by the reduction in rejected parts.

A number of GM divisions are currently using the process, and Ford is expected to start with 1960 models. Chrysler, so far, has not made up its mind. ■

See Competition for Small US Engine

PARIS—French aircraft manufacturer Henry Potez will go out for a piece of the small-engine market with a 90 hp engine interchangeable with the Continental C90.

Although certain exterior details of the Potez engine match the Continental 2475-rpm engine speed at rated hp—mounting points, carburetor air intake, and exhaust pipe location—basic design is different.

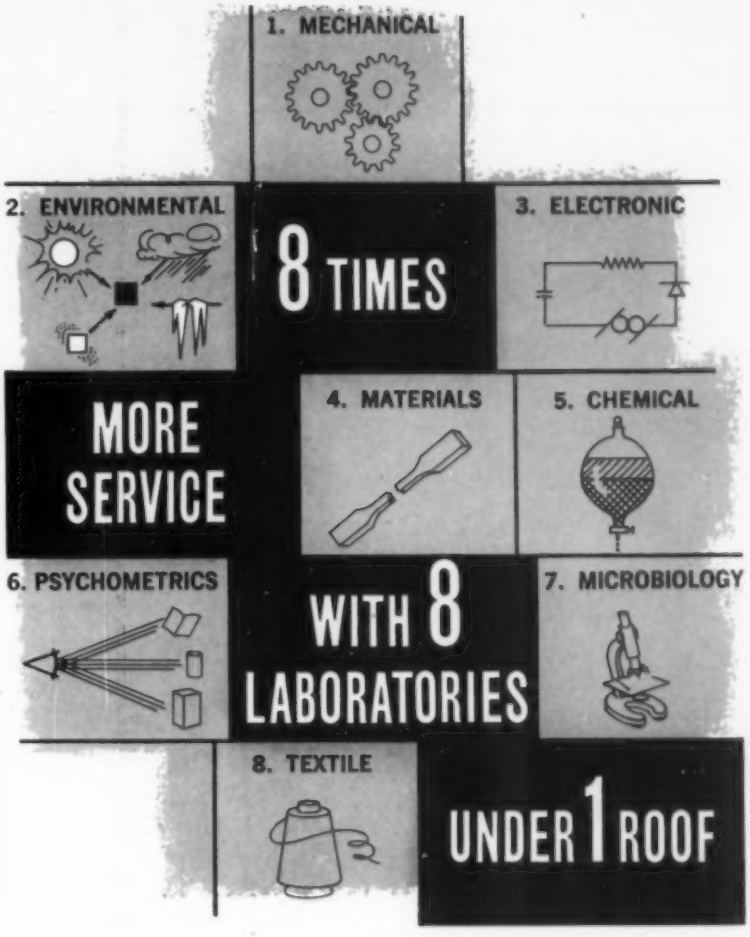
Heart of the four-cylinder, opposed, horizontal engine is a two-piece light alloy crankcase: steel cylinders with light-alloy heads attach to the crankcase by steel tie-rods. Camshaft and valve actuating mechanisms are at the top of the motor: intake and exhaust manifolds at the bottom. Carburetor is a Zenith type 42M200, with automatic altitude correction.

Design eliminates gear drives for accessories whenever possible: distributor drives directly off camshaft, oil pump off crankshaft. Except for the starter gearing, the motor has only one set of gears to drive the camshaft at half engine speed.

Another feature of the design, and a cost-cutting one, is a considerable use of automotive techniques. Ignition is automotive type, but with two sparkplugs per cylinder and two independent circuits. Both the generator and the starter motor are production automotive types. Crankshaft main and connecting rod bearings are thin-wall automotive types. With copper-lead-indium linings.

Basic specifications of the motor include takeoff power 96 hp at 2530

(Continued on page 30)



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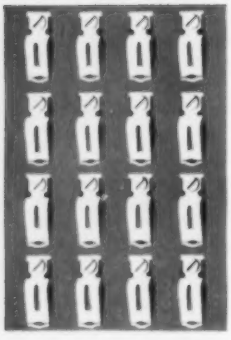

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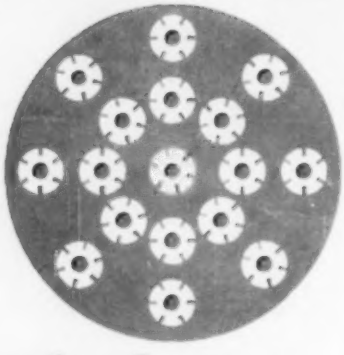

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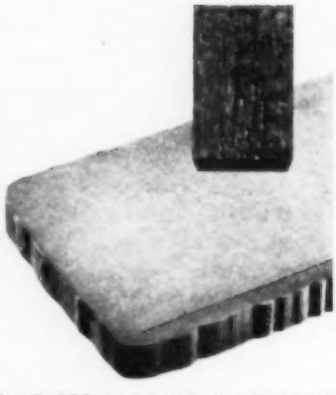

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rpm: maximum cruising power 68 hp at 2300 rpm: fuel consumption at maximum cruising power 230 grams/hp/hr: bore 110 mm, stroke 90 mm: compression ratio 7 to 1: weight 207 lb.

Potez, who has built eight prototypes of the new engine and has orders for some 300 more, says he could undersell Continental if he gets enough orders for his new engine. Price, not yet set, will depend on quantities produced: goal is 1000 units a year. Engine is being considered for military vehicles as well as light aircraft applications. ■

Automation May Serve USSR Consumer

LOS ANGELES—The Soviets are now applying automation primarily to heavy industry, but will eventually apply it to production of consumer goods, according to Dr Eugene M. Grabbe, senior staff consultant on automation, Thompson Ramo Wooldridge Inc.

Dr Grabbe was a member of a 13-man exchange group that toured Russian automation facilities last year. He recounted his observations here before the Industrial Engineering & Management Lecture Forum sponsored by the American Society of Mechanical Engineers.

Automation of consumer industries is forthcoming, the automation specialist believed, because Soviet industry is driving energetically to catch up with the US standard of living.

The Soviets have little exerience in design of complicated automation systems, especially for consumer goods, he said. Hence they are anxious to gain know-how from the West.

Because of heavy demand, the Soviets copy foreign equipment, thereby eliminating the R & D phase, Dr Grabbe continued. This practice trims budgets but precludes the Soviets from gaining experience in the R & D phase of industry. However, in isolated areas where they have concentrated R & D effort, some designs surpass ours. The products of Soviet factories are reliable and adequately designed, he added. ■

Experiment to Combat Engineer Shortage

NEW YORK—The nation's universities are experimenting with programs to combat deficiencies in engineering

(*Continued on page 32*)

BRIGHT DISPLAY

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Raytheon's two-gun memory tube makes possible MEMRAD,* a new approach to radar data display. In addition to its other capabilities, MEMRAD adds a new dimension in improving the detectability of targets by making possible the correlation of scan-to-scan data.

The PPI display is a continuous bright picture presentation, eliminating the conventional bursts of information. The system permits viewing with normal room illumination at any number of locations on standard TV-type monitors. Manual plotting is eliminated entirely. Furthermore, recognition and comprehension of target trails are made possible by presenting the recent history of target position. MEMRAD allows an immediate assessment of target velocity and maneuver, permitting discrimination between jet and conventional aircraft.

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NEW HAMPSHIRE BEARING ABSTRACTS

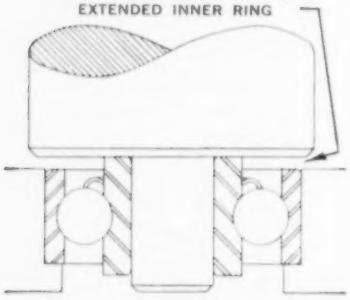
by **A. N. DANIELS**, *President*
New Hampshire Ball Bearings, Inc.

PRICES GO DOWN AS DEMAND GOES UP FOR EXTENDED INNER RING BEARINGS

Miniature bearings with extended inners now cost less than ever before. New Hampshire Ball Bearings, Inc., has cut price additives as much as 72%. This surprising reversal of recent price trends has been made possible by production economies brought about by sharply increased demand.

This return to popularity of extended inners is not surprising to New Hampshire's design engineers. Belief in the inherent advantages of the extended inner ring prompted their inclusion in the widely distributed Technical Bulletin and Catalog published in 1956. Since then, they have been specified in increasing quantities for gear trains and other designs calling for ease of mounting, firm seating and high tolerances.

CLEARANCE "BUILT IN" BY EXTENDED INNER RING



FEATURES OF EXTENDED INNERS

The above drawing illustrates the function of the extended inner. It insures clearance between the outer ring and a shoulder, a flat gear face or any other surface against which the bearing is mounted. This clearance allows the ring to revolve independently even when there are thrust loads and axial play. The importance of this clearance cannot be over-emphasized. When a small bearing is mounted to a larger element, the outer ring must not be allowed to come in contact with the larger element, or the two rings will not be independent.

This clearance must be more than just a minimum. The outer ring must have space for axial play particularly when there is any degree of thrust load involved. That's why New Hampshire Ball Bearings, Inc., extends the inner ring .0156 in. on each side. This provides ample clearance.

There are, of course, other means than extended inners to provide the necessary clearance. You can assemble a sleeve or washer on the shaft between the inner ring and the neighboring surface. Or, if the bearing contacts a gear, you can provide the gear with a hub.

However, the extended inner has two advantages over a washer or sleeve. It not only saves assembly time and cost, but also gives the bearing the firmest possible seat on the shaft.

MEET ABEC-7 STANDARDS

Moreover, the extended inner, manufactured to the same Class 7 tolerances as each and every New Hampshire ball bearing, guards against the possibility that a sleeve or washer produced less accurately may reduce the reliability of the assembly.

Complete specifications of New Hampshire plain and flanged retainer bearings with extended inner rings, with or without shields, are contained in our Design Handbook. Price quotations and delivery schedules on request.

DESIGNERS' HANDBOOK FREE TO ENGINEERS

If you work with miniature ball bearings, you'll find this 80-page, authoritative handbook contains a further discussion of extended inner ring bearings and is a great help in solving problems in designing instruments or electro-mechanical assemblies.

It will be sent free to qualified engineers, draftsmen and purchasing agents.

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education. One such program at the Univ of Illinois will accept 10 pioneer "engineering interns" into an experimental course starting next fall. Backed by a $207,000 Ford Foundation grant, this program will specially train the young men for engineering teaching careers.

The interns, who all graduate from college this spring, will divide the next two years between a master of science degree and instruction and practice in educational methods and theory under experienced teachers. Additionally, the students will participate in seminars to build their professional backgrounds. Illinois expects 10 more interns to be named during each of the next three years.

The Univ of Cincinnati will initiate a cooperative education curriculum next fall under which students will combine graduate studies and research in engineering and the physical sciences.

The university has administered a work-and-study plan on the undergraduate level for the past 53 years. On the new graduate level experiment, students will work on basic research problems in a field of mutual interest to the university faculty and the industry sponsor. The program is under direction of the College of Engineering and the Graduate School of Arts and Sciences. ■

Rubber-asbestos Helps S-P Rocket Motors

McGregor, Tex—A low-cost, lightweight insulation material, composed of rubber and asbestos, which will extend the capabilities of solid-propellant rocket motors for long-duration, high-thrust applications, has been developed for the Navy by Astrodyne, Inc.

The insulation material is considered a major technological breakthrough in the field of high-performance, long-duration solid-propellant rocket motors, the Navy said.

During the tests, while the motors utilized a high-performance solid propellant having a flame temperature in excess of 5500F, the new rubber-asbestos insulation held the exterior of the rocket motor case to approximately 200 F at the end of 3½ min. Presently used solid-propellant rocket

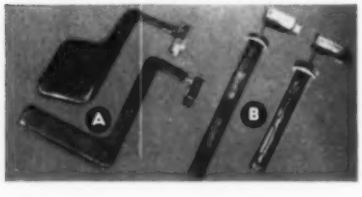
(*Continued on page 34*)

How to select cast-in immersion Heaters for Metal Melting Applications

Here is condensed information to help you get the most economical electric heater for any design problem where melting soft metals is a factor.

General Electric cast-in immersion heaters can be applied to virtually any process machine which uses soft metals in a molten state.

Two factors generally determine which General Electric cast-in immersion heaters should be used. They are: the physical characteristics of the machine or pot, and the temperature required.



"Over-the-side" immersion heaters (a), as their name implies, are merely suspended in the pot or crucible with their effective heating portions immersed directly in the metal. Installed in this manner, these heaters can be easily shifted to vary the heat distribution as required. Furthermore, these heaters can be added or replaced without shutting down the bath.

"Through-the-side" immersion heaters (b) are designed for relatively permanent mounting on the side of the crucible or pot by means of a gasketed flange header. This type of heater is best suited to smaller pots because of its relatively small radiating surface.

To figure the amount of heat required for your application:

1. Determine weight in pounds of the metal to be heated. (Volume of the pot in cubic feet x weight of metal in pounds per cubic foot from Table II.)

2. Determine operating temperature of metal bath from Table II.

3. Using the data obtained in Steps 1 and 2 above, read kilowatt hours from Table I.

4. Divide the answer obtained in Step 3 by the hours allowed for heat-up. You now know how many kilowatts of heat are required for your installation.

For complete information on sizes and ratings of General Electric heaters, call your General Electric Apparatus Sales Office or send coupon below.

DELIVERY TODAY: Popular sizes of General Electric heaters are available today from General Electric stocks near your plant.

SPECIAL SAMPLES: Your General Electric sales engineer can advise you on special heating problems. If special heaters are required, he will provide samples.

PROMPT SHIPMENT: General Electric's new Industrial Heating plant at Shelbyville, Indiana, is now geared to give excellent shipping dates on heaters for your production needs. Just call your nearest General Electric Apparatus Sales Office and tell us your requirements. General Electric Company, Schenectady 5, New York.

TABLE II METAL MELTING DATA

Metal	Wt in Lb per Cu Ft	Melting Temperature in Deg F	Heat Required to Melt 1 Lb		Watt-hours Required to Heat 1 Lb 1 F from Melting Temp.	Usual Operating Temp. in Deg F	Watt-hours Required to Bring 1 Lb to Working Temp.
			Btu	Watt-hours			
Lead	710	620	28	8.3	0.0098	725	9.2
Tin	455	450	47.5	14.0	.0187	600	16.7
Solder (1 part tin, 1 part lead)	555	400	33	9.6	.0152	650	13.8
Solder (2 parts tin, 1 part lead)	520	365	38.8	11.4	.0171	520	13

TABLE I TO DETERMINE KW HOURS

Weight in Lb	Solder			Solder			Tin			Lead		
	2 Parts Tin, 1 Part Lead			1 Part Tin, 1 Part Lead								
	470°F	520°F	570°F	600°F	650°F	700°F	550°F	600°F	650°F	700°F	725°F	750°F
	KW Hours			KW Hours			KW Hours			KW Hours		
100	2.3	2.4	2.5	2.3	2.4	2.5	2.7	2.8	2.9	2.5	2.6	2.7
500	9.3	10.0	10.7	9.6	10.1	10.7	11.5	12.0	12.5	4.7	5.2	5.7
1,000	18.3	19.3	20.3	18.6	19.7	20.8	22.5	23.5	24.5	18.1	19.1	20.1
1,500	25.5	27.0	28.5	33.7	35.2	36.7	32.0	33.5	35.0	23.9	25.4	26.9
2,000	38.0	40.2	42.5	46.5	48.5	50.5	47.0	49.0	51.0	33.0	35.0	37.0
2,500	46.0	48.0	50.2	54.0	57.0	59.5	56.0	58.5	71.0	44.3	46.8	49.3
3,000	52.0	56.0	60.3	61.3	64.6	67.8	66.0	70.0	74.0	50.0	53.0	56.0
3,500	60.0	64.0	68.5	68.7	72.4	77.0	75.0	79.0	83.0	56.0	59.5	63.5
4,000	67.0	71.5	76.5	76.5	80.7	85.0	84.0	89.5	94.5	62.0	66.5	70.5
4,500	75.0	81.0	87.5	83.5	89.0	95.0	94.0	100.0	105.0	68.0	73.0	78.0

GENERAL ELECTRIC

Section E723-27, General Electric Co.
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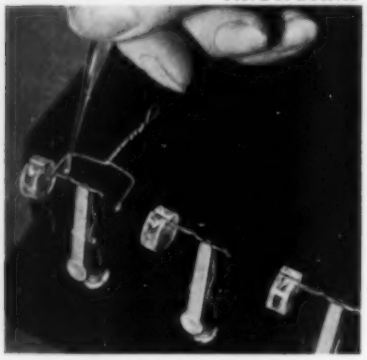


Eastman 910 Adhesive solves another production bottleneck

Universal Transistor Products Corp., Westbury, New York, makes a direct-reading precision radiation monitoring instrument, called a dosimeter.

Assembly of the pocket instrument requires careful attachment of the sensing element, an extremely delicate quartz fiber, to two pips on a fine aluminum wire.

This seemingly difficult operation is handled on a production-line basis with speed and simplicity by properly positioning the fiber, which is temporarily held in a Y-shaped support, and then cementing it to each pip with a drop of Eastman 910 Adhesive.

In less than one minute, the bond is formed.

Eastman 910 Adhesive is making possible faster, more economical assembly-line operations and new design approaches for many products. It is ideal where extreme speed of setting is important, or where design requirements involve joining small surfaces, complex mechanical fasteners or heat-sensitive elements.

Eastman 910 Adhesive is simple to use. No mixing, heat or pressure is required. Upon spreading into a thin film between two surfaces, setting begins immediately. With most materials, strong bonds are made in minutes.

What production or design problem can this unique adhesive solve for you?

Bonds Almost Instantly ...Without Heat, Pressure or Catalyst

For a trial quantity (⅓-ounce) send five dollars to Armstrong Cork Company, Industrial Adhesives Division, 9106 Irvin Street, Lancaster, Pa., or to Eastman Chemical Products, Inc., Chemicals Division, Dept. P-6, Kingsport, Tenn.

motors have durations from a few seconds to only approximately one minute.

The material is lighter in weight, lower in cost and provides improved high-temperature insulation properties when compared to high-cost reinforced plastic insulation currently used in some rocket motors. ■

Transcriber Speaks Computing Languages

WASHINGTON—A device that facilitates communication between various computing systems has been developed by the Dahlgren Naval Proving Ground Computing Center near here. Called a transcriber, the device is a flexible computer with a stored program of computing system codes. It can make transcriptions of magnetic tapes or punched cards from one computing system code to almost any other without reprogramming the system.

It is expected that computing systems separated by great distances can now be used jointly by shipping the tapes or cards of one system to the transcriber, then using their transcription on another system. ■

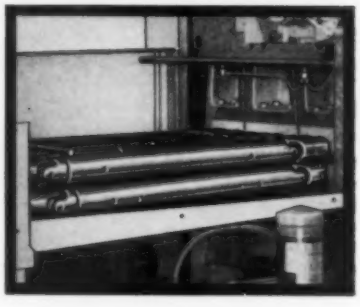
US Imposes Bans on Export of Technology

WASHINGTON—The US is tightening restrictions against export of technical know-how to the USSR and Soviet bloc nations. Two directives have been issued by the Commerce Department's Bureau of Foreign Commerce—the agency that regulates US trade in commodities and technology.

One directive, in effect June 1, applies to manufacturers of civil aircraft and parts and certain types of electronic and radar equipment. Henceforth, these companies will be required to get a Validated Export License to send any unpublished proprietary data on company R & D or manufacturing techniques abroad.

The other directive in effect on June 8 applies to producers of petroleum and petrochemicals. These companies can continue to send unpublished technical data abroad under general export licenses, but now they must first have written assurances from the foreign company that the data (or products that result from use of the data) will not be exported to the Soviet bloc. ■

HOW CURTIS SOLVED A CLOSE CENTER-TO-CENTER PROBLEM



The close center-to-center spacing of these drive spindles on a Sutton-Maust Precision Backed-up Roller Leveler created a tough problem for its manufacturer. He needed a universal joint strong enough to stand up under heavy rolling mill conditions, yet small enough to operate at such close quarters.

The answer was a Curtis universal joint! The maximum load carrying capacity and minimum torsional deflection of the Curtis joint was found to be completely satisfactory. And Curtis' famous Telltale Lock Ring construction permits quick disassembly for easier maintenance.

This is just one of the many power transmission problems solved by Curtis universal joints — size for size the *strongest* universal joints designed for industry. Selected materials, precision engineering, and 40 years' experience manufacturing universal joints exclusively make them that way.

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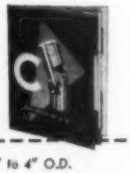

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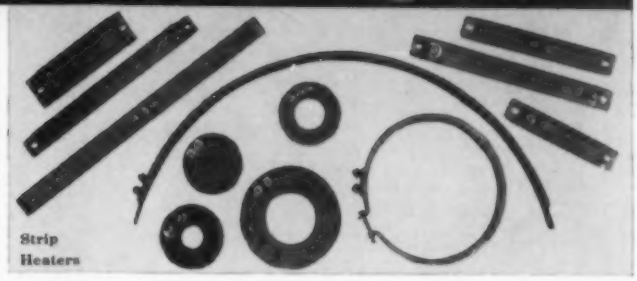
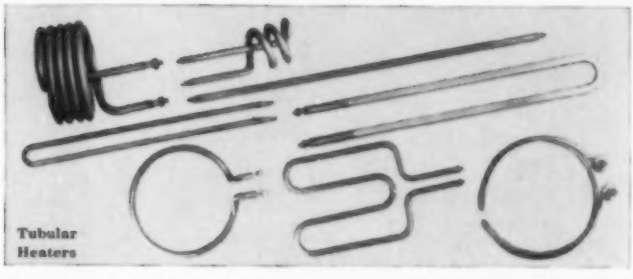
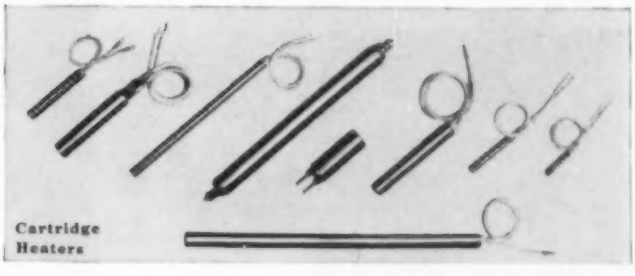


Strip Heaters



Tubular Heaters



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Strip Heaters . . . that quickly and easily bolt or clamp to platens, dies, kettles, tanks, pipes, rolls, drums, ovens and air ducts. Lengths from 4 to 96 inches, widths from ¾ to 2½ inches, with cross section curving or lengthwise bending. Available with brazed-on fins.

Tubular Heaters . . . that clamp on, fit into machined grooves, cast into metals, immerse in liquids, install in ovens and ducts. Straight lengths or factory-formed to nearly any contour. Lengths from 6 inches to 30 feet. Triangular or round cross section. Available with brazed-on fins.

Cartridge Heaters . . . that smoothly fit standard drilled holes in dies, platens, molds, extrusion and injection barrels. Special leads available for protection against flexing action, abrasion, moisture or vapors. Diameters from ⅜ to 1 19/64 inches, lengths from 1⅝ to 25⅜ inches.

Versatile Chromalox electric heaters are available in sheath materials and wattages to match almost any application to 1100°F. Easy to install, they are fast, clean, safe and economical.

Your Chromalox Man can help you determine the one that best answers your specific problem. He's backed by the world's largest factory stock of industrial heaters, ready for immediate shipment. Why not give him a call. You'll find his phone number listed at the right.

Our new Catalog 60 provides detailed product information and suggests numerous applications for the complete line of Chromalox electric heaters for industry. If you have not yet received a copy, please let us know.

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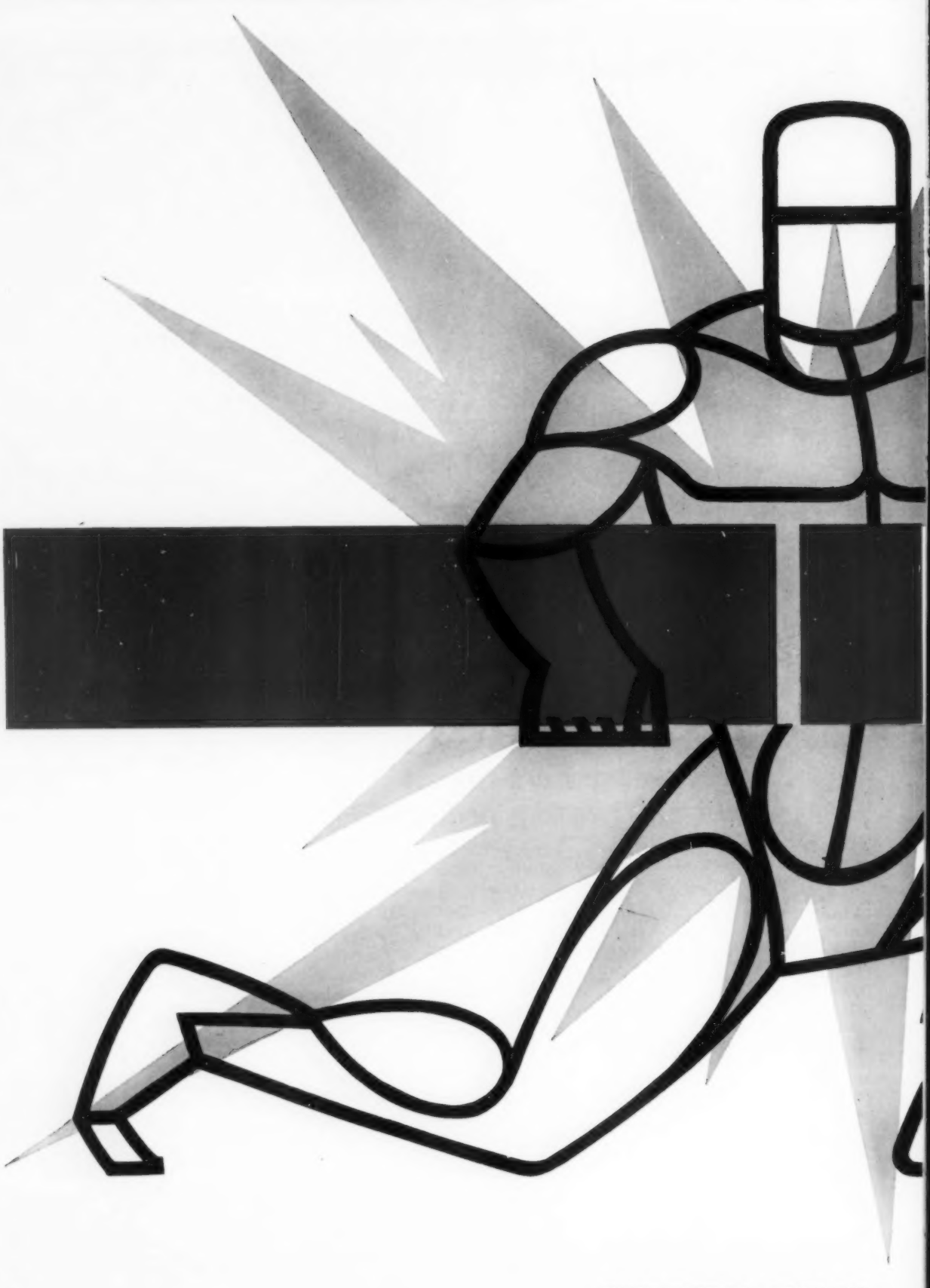

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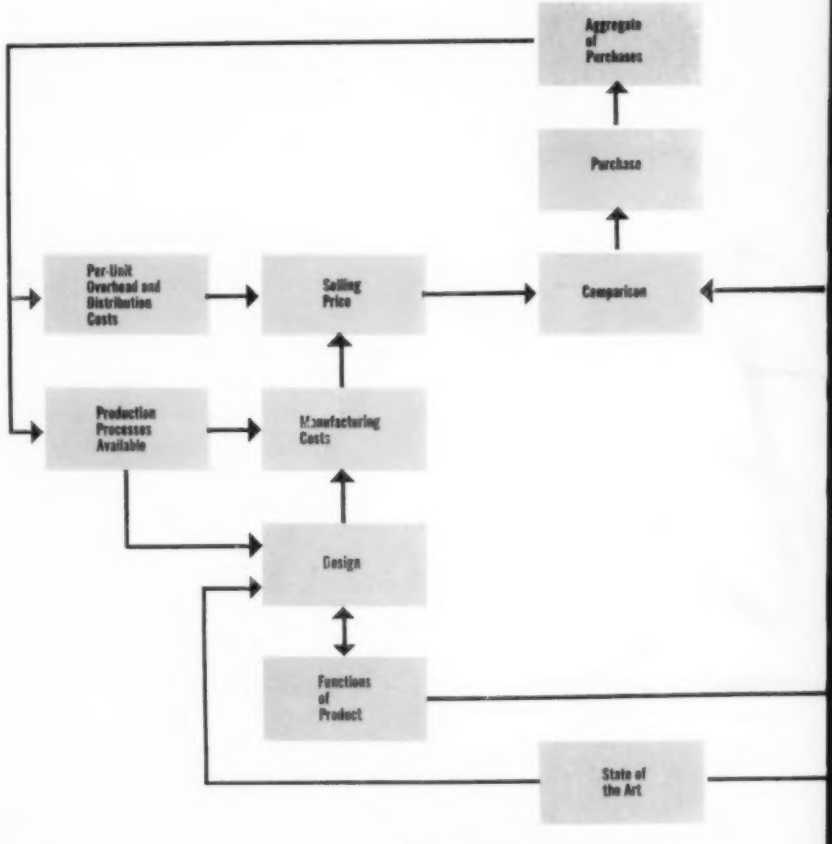
the TECHNICAL SURVEY... WHY and HOW

An application or the systems-engineering approach to market research on radically new technical products.

WILLIAM S BENNETT
senior project designer
Designers for Industry Inc
Cleveland

When a manufacturer plans to introduce a new and different technical product, he often finds himself facing a dilemma. He knows that he should do a certain amount of market research to find out "what the customers want" and "how much they will pay." But if the product is radically different from established ones, the customers simply do not know what they want, or will want. Honest customers tell him, "I haven't figured it all out yet, and I won't until I have to. But I'll take the product that does the best job for me at the least price." Unthinking customers may give him solid-sounding answers, but later they won't act according to their words.

The problem here is that the manufacturer's capabilities, the state of the art, and the customers' needs are all interdependent in a complex way. The customers' needs are relative: people "need" electronic computers today where yesterday desk calculators or slide rules were adequate. Computers would have been extremely useful but they weren't available, so no one thought anything of it. Now the state of the art, and the capability of computer manufacturers, is such that



suddenly all kinds of people "need" computers. And so they do; competition forces them to it.

And when a customer is just becoming aware that he needs some product, he is not at all sure of the exact shape it should take, the exact functions it should have, or what price he can justify for it. Very often it takes a great deal of study and trial before he knows these things well enough to purchase intelligently.

Now suppose the manufacturer is very ambitious, and wants to be ahead of his competitors. He wants to market a product just as the need for it becomes general so that he can cash in on the high-profit period. To do this, he must be able to detect when the state of the art (in both the product and the customers' operations) is almost ready for the product—because he needs development time, but does not want to risk development cost on something which is too far ahead of the state of the art.

The manufacturer cannot depend upon the customer to tell him these things. Surveys galore, scientifically accurate as they may be, cannot elicit from customers what they do not know, or have not yet thought through.

Manufacturers in such a predicament rely on different methods: the wisdom and judgment of an experienced man in the organization, pure gamblers' gall, or cautious "watchful waiting". Waiting is safe but unprofitable. Gambling is not safe at all. And it is a rare man indeed who can predict with genuine accuracy just what functions, just what price, and just what market a very new product should have.

The effect of a mistake can take various forms: A set of functions can be built into the product which have no beneficial effect on the customers' operations; or the functions are too elaborate, costing far too much to produce many sales; or the function's effect on customers' operations may be duplicated by a cheaper product or method of operation. Sometimes a set of functions is chosen which would have a tremendous beneficial effect, but unfortunately cannot be achieved in a design within the state of the art.

The systems approach

There are so many interacting factors in this kind of problem that one wonders whether a systems-engineering approach could not be used—one in which all the variables could be related and the product "optimized" over the entire set. Such an approach is possible; and when it is properly executed, can result in a much better "impedance match" between product functions and price, between manufacturer and market.

In systems engineering, the operation of a group of components is studied as if the group were one large device. Mathematical treatment, tests, environmental investigations, are carried out as if for a single huge component. The design goal of any one of the small components is subject to the common good of the system as a whole.

The situation in market-research work is exactly analogous: market studies on well-established products can proceed with reasonable success merely by considering each market factor separately. But market research on radically new, technically complex products requires an integrated or systems approach because the various elements in the market picture interact upon one another in a much more intricate way.

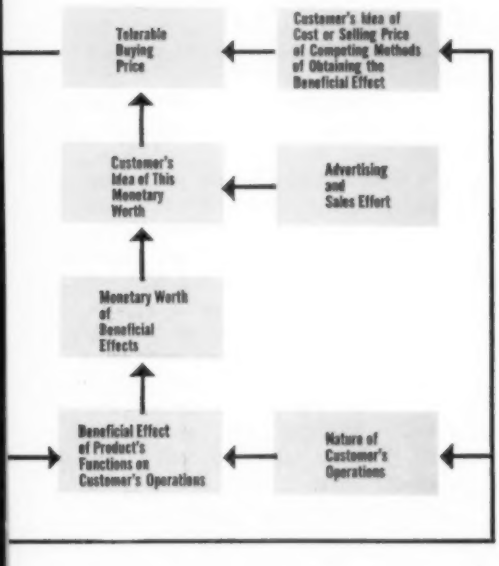
The block diagram at left is an attempt to sketch out the market for a technical product. This is a causation diagram, and not mathematically precise. The arrows between boxes mean, "help to determine."

The focal point of the system is the box at lower left labeled "functions of product." This is the link which ties together the manufacturer and the user of the product.

Any product has functions, here meant to include not only primary functions but also such things as the effect which the appearance of the product has on an observer, its environmental resistance, and so on—any important physical relationship between the product and its application. These functions have (it is hoped) some beneficial effects on the customers' operations (in the broadest sense). The effect is, of course, strongly influenced by the nature of the customers' operations—an electron microscope may be valuable in a research laboratory but quite useless in a department store.

The beneficial effect will have a certain monetary value to the customer, However, the customer's idea of this monetary worth may not be accurate—most often he tends to underestimate it. Advertising and sales effort can bring him facts which will raise his idea of the monetary worth up to its real level.

The customer's idea of the monetary worth of the product's beneficial effects does not, however, completely determine what he is willing to pay. The "tolerable buying price" depends


Tolerable Buying Price
Customer's Idea of Cost or Selling Price of Competing Methods of Obtaining the Beneficial Effect
Customer's Idea of This Monetary Worth
Advertising and Sales Effort
Monetary Worth of Beneficial Effects
Beneficial Effect of Product's Functions on Customer's Operations
Nature of Customer's Operations

This system analysis of a technical product makes it possible to produce a better "impedance match" between manufacturer (left side of diagram) and customer (right side).

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the TECHNICAL SURVEY . . . (CONTINUED)

also upon the customer's idea of the cost (or selling price) of the competing methods of obtaining the same beneficial effect—other products, or perhaps just a change in plant operations. If, for instance, the product is a steam engine and the beneficial effect involved is a 1-hp rotary motion, then the monetary worth of the effect to the customer will be strongly influenced by the fact that a 1-hp electric motor is available to do the same job at much lower cost.

The diagram is best followed at this point by returning to the "functions of the product." Functions dictate design—if you include environmental conditions, maintainability, economy, and so on, under the functions of which the product must be capable. Design, in turn, affects manufacturing costs, but the production processes which are available to make the product also affect these costs.

Manufacturing costs, in conjunction with unit overhead and distribution costs, determine the selling price. (Profit has been omitted from the diagram, assuming that it is an elastic item, under complete control.)

At the bottom of the diagram, there is a box labeled "state of the art." It affects at least three other boxes directly: product design, customers' operations, and competing methods of obtaining the beneficial effect.

At the psychological "point of sale"

The customer makes a comparison between his tolerable buying price and the selling price of the product. If it is favorable to him, he will make the purchase. Aggregates of purchase made by many customers will, first of all, reduce the per-unit overhead and distribution costs, thus providing a feedback which reduces selling price and generates higher sales. Later, the increased sales enable the production processes to be adapted to high-volume production, providing a second feedback which further reduces selling price and generates still more sales.

The system is truly regenerative—that is, if it gets off the ground at all. And to do that, all the parts of this system have to contribute to the favorable comparison at the top. The technical survey goes about exploring this system in a methodical way, to determine ahead of time whether all the parts will work—whether the product will indeed get off the ground.

First step is to study the whole diagram in relation to the proposed product: preliminary list of functions and specifications, nature of the customers' operations, competing products and processes, manufacturing processes available in the plant to make the product, state of the art in design of this kind of product, new advances in the state of the art in the customers' operations.

All of these facts are written down in compact, easily grasped form. Sometimes, when the facts seem to point clearly to a given set of specifications for the product, a model of the product is made to those specs.

Then, and only then, the prospective users of the product are contacted. Letters are written to the executive vice-presidents of these organizations, asking for an interview with "the man in your organization best qualified to discuss this product"—not a purchasing agent, but (in most cases) a practicing engineer who thoroughly understands his company's operations.

To this man is presented the entire system analysis. If a model of the product was built, it is taken along and operated for him. He is asked to comment on the analysis, pointing out places he believes inaccurate, and adding missing facts.

After 25 or 30 competent engineers in different prospective user organizations have helped to work over the system analysis, it becomes quite sound. It can be relied upon much more than a shallow canvass because it does not depend upon the customers' fleeting thoughts of something they have never before considered: it depends instead upon painstaking logical deduction, carefully explained to— and corroborated by—the customer's technically trained representative.

Because of this, the technical survey is capable of detecting applications of radically new products to rapidly changing operations soon enough to allow adequate development time for the product. Guesswork, gambling, and waiting are drastically reduced, and both groups benefit. The manufacturer sells his product in the high-profit period; and the customers take advantage of advanced operating methods sooner than they otherwise would. ■

greater heat resistance

Buna N/Nylon Reevecote lasts twice as long at elevated temperatures—with no added costs!

When it comes to taking the heat, you just can't put regular diaphragm material in the same class with this new development from the Reeves-Vulcan laboratories.

Over the past two years, extensive tests compared the performance of the new Heat-Resistant line with standard coated fabrics. The tests proved conclusively that **the new Reevecote line provided up to 100% improvement in resistance to stiffening and cracking.** The new fabric has improved resistance to oils, solvents and gas condensates.

The new Reevecote Heat-Resistant line is now available in twelve different combinations of gauges and tensile strengths. For **all** your requirements, you can be sure if you specify Reevecote, **the one complete source of engineered industrial coated fabrics.** For specifications on the complete Reevecote line, write for **free catalog** — no obligation.

Another

REEVES VULCAN

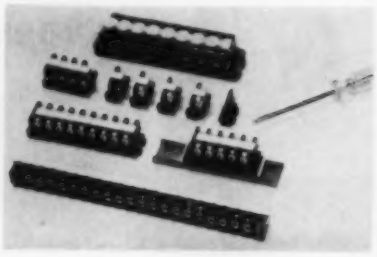
RUBBER PRODUCT

REEVES BROTHERS, INC.

1071 Avenue of the Americas • New York 18, N. Y.

TRENDS in appearance design . . .

†Lubricator-filter-regulator unit for fog lubrication is made by C. A. Norgren Co, Englewood, Colo. Components are assembled in what is probably one of the simplest possible arrangements, according to intended function. Unfortunately decal identification all but overwhelms handsome glass elements.



Terminal blocks for heavy and medium duty made by Buchanan Electrical Products Corp, Hillside, NJ, show how repetition of strong, clean-lined forms can constitute interesting design in themselves. Made only in black and white at present, addition of color would add even more effectiveness and could be put to various functional uses.

AN INDUSTRIAL DESIGNER

← Two and three-wire electric plugs made by Miller Electric Co, Pawtucket, RI, for power tools, appliances, computers, machinery, use integral color inherent in plastics of which they are molded to complement or contrast with products to which they are applied. They reflect a functionally mimimal use of material and bulk and their forms indicate awareness of pull-out action and strains to which they are subjected. In some, decorative detailing is unnecessary and dated.

by JOSEPH CARREIRO, Director, Industrial Design Dept, Philadelphia College of Art; Senior Partner, Carreiro Design Associates

Of the eleven OEM products shown here, which I selected at the 1959 Design Engineering Show for their superior appearance design characteristics, only two were ever worked on by industrial designers. Whatever styling was achieved with the other 9 was apparently done within the manufacturers' organizations, probably by the engineering staffs themselves. Perhaps the engineer achieved above-average appearance in these components by permitting only the end functions and operating requirements to dictate contours and the arrangement of the necessary parts.

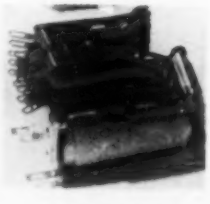
As for the Show as a whole, I am afraid that the design quality of the various exhibits was in most cases much higher than that of the components displayed in them—yet the majority cannot but have decisive effects on the appearance of the end products in which they are made to be used. And the effects are likely to be both more telling and more lasting than the exhibits themselves can ever have on the visiting engineer-customer. Perhaps the exhibit designer has an easier time of it with management—he is probably not asked to fulfill any more than his normal functions as display expert and professional. Besides, everyone generally agrees on the basic, minimum tasks that an exhibit should be designed to fulfill.

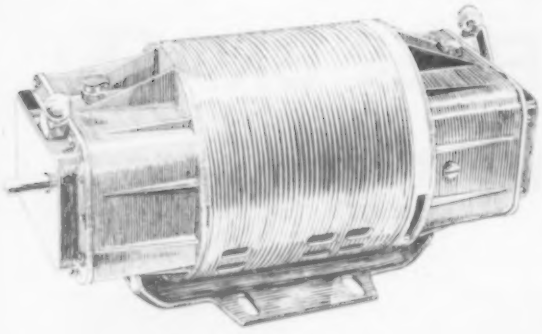
Too often, the product design engineer is asked to style a product only *after* he has succeeded in fulfilling management's requirements as to function, and despite the fact that he has probably had none of the required training and experience in industrial design.

At every one of the Design Shows I have visited, I have been impressed by the rich, almost unlimited selection of materials that the engineer can choose from—in fact, variety exists to the point of confusion. Also, I found that a number of the newer metallics and nonmetallics are still in that stage of their development where they are being used too often to imitate other materials and to provide effects alien to their own attributes.

Touring the booths at the Show I would occasionally find products where the basic forms had evolved in the engineer's hands into sensitive and expressive wholes. But too often, necessary details such as joints and junctures, vents, finishes, and graphics (such as nameplates and dials) had been permitted to detract from a product's natural gracefulness. Very often the best results in terms of appearance occurred where a pattern inherent in the engineering design of a product dictated the arrangement of parts. Relays are often a good example of this, and it is too bad that most often they must be enclosed in the end product in such a way that we cannot enjoy their frequently attractive appearance. Relays are also a good example of another ingredient of many good product designs, repetition. The stacked leaves in a relay, or the modules in a terminal block, probably catch our eye just because repetition of strong, clean forms has created an effective pattern. ■

† Self-cooling speed reducer by Ohio Gear Co, Cleveland, achieves massiveness in its cast housing and thus looks rugged. But fins are emphasized too much, and treatment of graphics is not consistent.





Double-ended speed regulator manufactured by Revco, Inc, Minneapolis, provides independently variable control at each shaft, from zero to 400 rpm. Silhouette has been kept simple, and consists solely of functional elements. However, identifying nameplates are oversized and hence distracting.

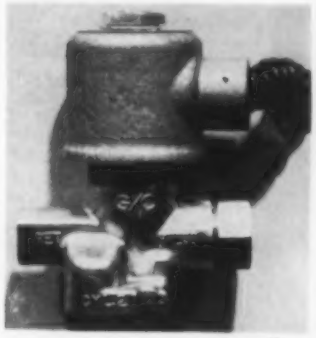
Double footswitch for dictation transcribing machine by Linemaster Switch Corp, Woodstock, Conn, is clean, crisp and direct and exhibits a fairly good use of color. Nameplate could be better.

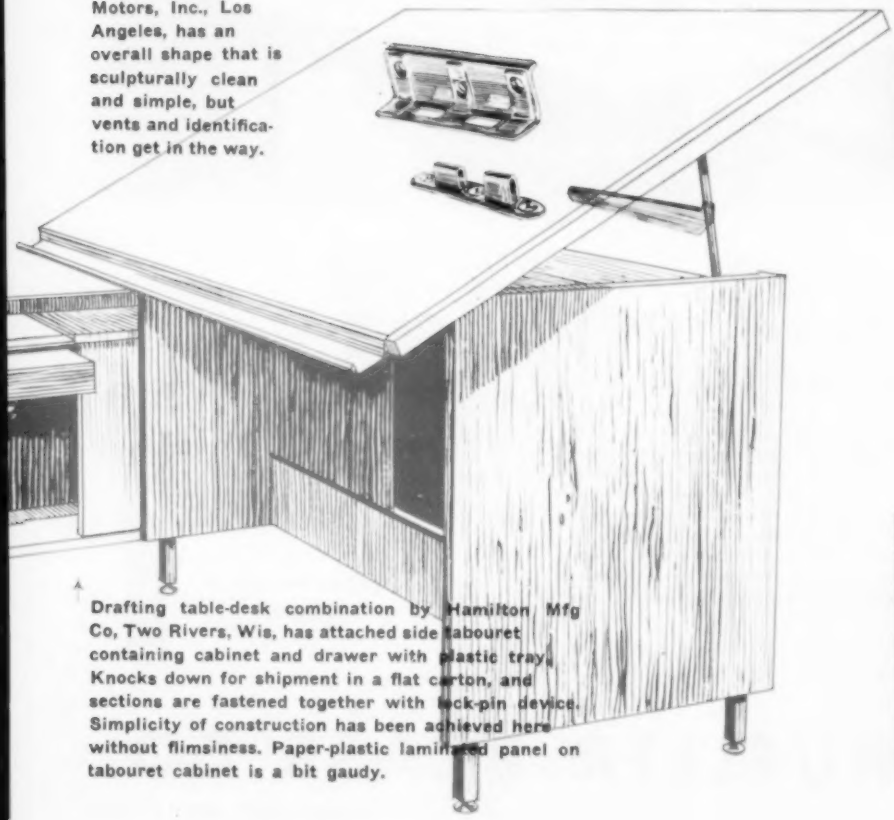
EYES THE DESIGN SHOW

Right-angle gear motor, made in ⅓ to 2 hp ratings by U S Electrical Motors, Inc., Los Angeles, has an overall shape that is sculpturally clean and simple, but vents and identification get in the way.

Indicating dial for rotisserie control by General Controls, Glendale, Calif, displays handsome use of graphic elements, but is it too small for legibility?

Magnetic solenoid valve for air, gas or oil by General Controls Co, Glendale, Calif, is typical of this type of product, in that the cast valve body has a functional sculptured look surmounted by a solenoid housing that doesn't live up to it.





Drafting table-desk combination by Hamilton Mfg Co, Two Rivers, Wis, has attached side tabouret containing cabinet and drawer with plastic tray. Knocks down for shipment in a flat carton, and sections are fastened together with lock-pin device. Simplicity of construction has been achieved here without flimsiness. Paper-plastic laminated panel on tabouret cabinet is a bit gaudy.

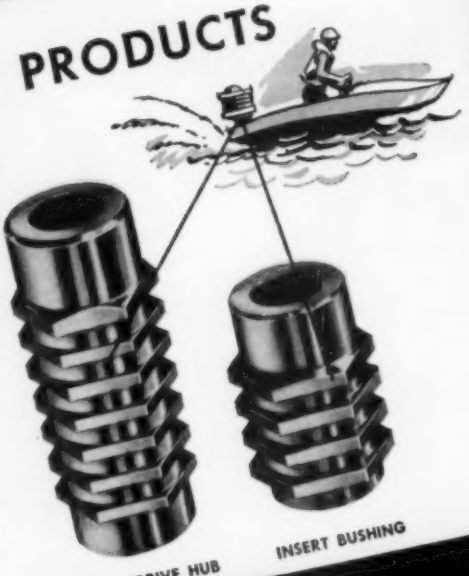
Thermostatic heater control by General Controls, Glendale, Calif, consists of rectilinear shapes that contrast effectively with round knob.

two typical cases where MUELLER BRASS *determined the best and most*

CASE HISTORY 1750

SCREW MACHINE PRODUCTS for outboard motors

Mueller Brass Co. Methods Analysis Engineers, after careful consideration of every aspect of the job requirements, found that the best method of producing these 2 outboard motor parts at the lowest cost was as screw machine products made from hollow hex rod. The insert drive hub and insert bushing are used in the lower units of one of America's most powerful outboards and must absorb constant punishment without failing. Mueller Brass Co. has one of the world's largest automatic screw machine departments fabricating both ferrous and non-ferrous custom parts. Parts can be produced in an infinite variety of shapes and sizes from ⅛" to 3¼" in a wide range of free cutting and specialized alloys. Complete facilities are available for all secondary and finishing operations, as well.



INSERT DRIVE HUB

INSERT BUSHING

THE MAN FROM MUELLER BRASS CO.

can give you sound, unbiased advice on the one best method of making your parts because Mueller Brass Co. is the only fabricator in the country offering all these methods of production. An experienced "Methods Analysis Department" has at its command a complete knowledge of the advantages and limitations of each production process. This unique technical service is your assurance of getting the best product at the best price . . . made the one best way.

FORGINGS

PLASTIC INJECTION MOLDING

MUELLER BRASS CO.

CO. METHODS · ANALYSIS · SERVICE

economical method of producing parts

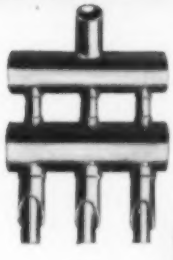
CASE HISTORY 226

COLD-PREST® IMPACT EXTRUSION for door closer cylinder

By producing this door closer cylinder as a Cold-Prest Impact Extrusion, several important advantages are realized: formerly made in three pieces, the part is now made as one piece in one operation which eliminates machining and assembly operations. The possibility of leakage is eliminated and the part has better physical properties, as well as a smooth, bright finish. Mueller Brass Co. has complete facilities for producing Cold-Prest impact extrusions of aluminum, copper, brass, bronze and steel. Square, rectangular and cylindrical shells up to 28" in length are possible depending on wall thickness and other design details. Parts can be designed having ribs, flutes, splines or bosses . . . with multiple wall diameters and with various wall sections.

POWDERED METAL PARTS

SAND CASTINGS



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Write today for engineering manuals covering all these production processes.

PORT HURON 22, MICHIGAN

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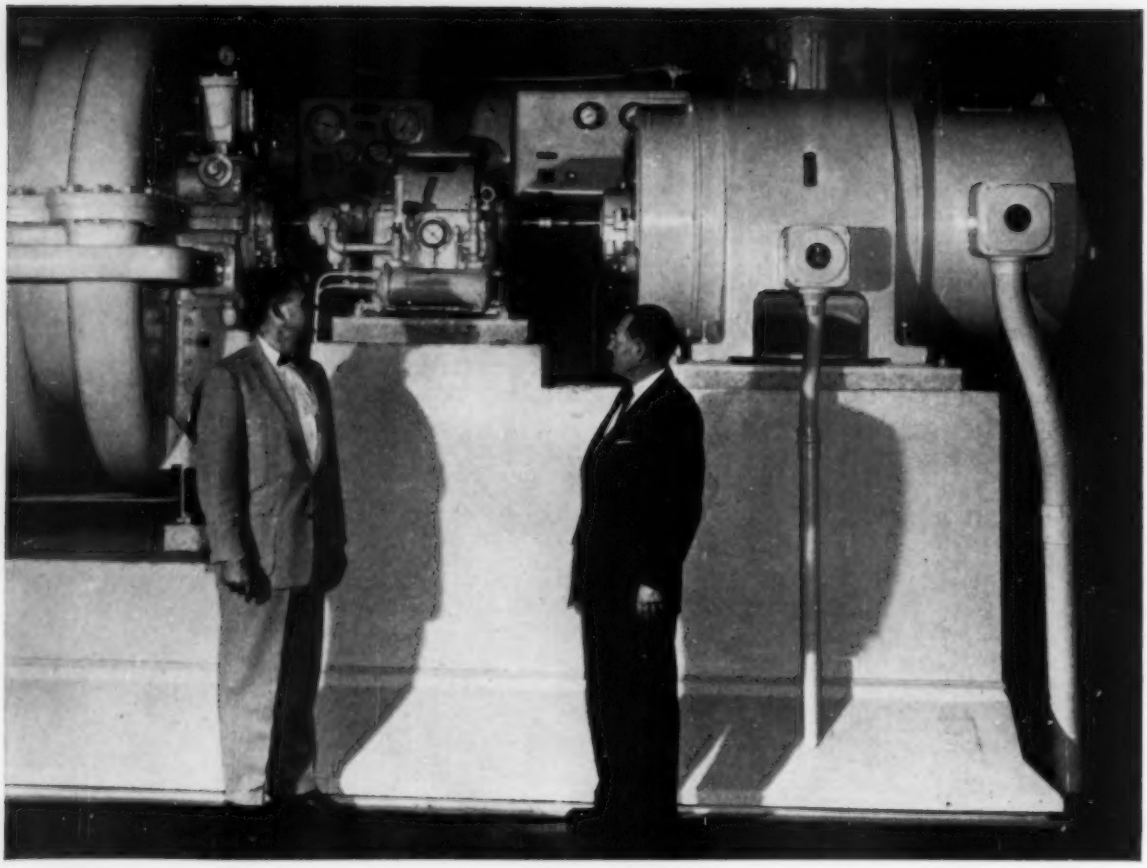

One of two Fairbanks-Morse 4160 volt, 700 hp. slip ring motors which power Carrier refrigeration compressors.

8-speed climate with F-M motors!

Flexible control of new air conditioning system saves power and maintenance for Union Oil Center

Through a new Carrier dual-duct high-velocity system powered by Fairbanks-Morse slip ring motors, the magnificent new Union Oil Center in Los Angeles is ideally air-conditioned at minimum power and maintenance cost.

Providing 8 speeds between 75 and 100 percent of capacity, the two F-M 700 hp. motors make it possible to match operating rpm. of compressors, chillers and condensers to any specific condition. The new Center covers 5 acres, with 1200 employees occupying 426,000 square feet of the office space in a complex of four buildings—an installation requiring the finest in air-conditioning equipment and components.

Fairbanks-Morse offers the distinct advantage of a broad range of alternating and direct current motors, in all types, and in ratings from ½ to 10,000 hp.

For expert assistance in specifying, write Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago 5, Illinois.

New Union Oil Center in Los Angeles.

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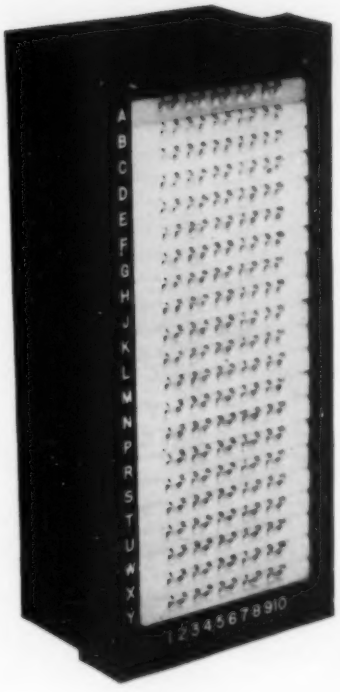
ELECTRIC MOTORS • GENERATORS • PUMPS • SCALES • DIESEL, DUAL FUEL AND GAS ENGINES • LOCOMOTIVES • COMPRESSORS • MAGNETOS • HOME WATER SYSTEMS

SIGNIFICANT COMPONENTS MATERIALS PROCESSES

Fluid-flow motor control . . .

designed primarily as a pumping-unit protection switch, can protect numerous hydraulic systems with components that depend on min fluid-flow rate for such functions as lubrication and cooling. Ambient-temperature-compensated, thermal time-delay switch permits fluid to start up and attain normal flow rate before taking over control of electrical circuit. Retains positive contact pressure, even under severe vibration, yet opens circuit in 3 sec minimum when necessary and remains open indefinitely through use of auxiliary heater contact with make-break regulation. Can be mounted in any position, anywhere in the pump pressure line, and offers little flow restriction. Corrosion-resistant control is said to be sensitive to min flow rate, as well as flow failure, though impervious to extraneous materials such as sand and scale. Preset at factory. Standard unit handles working pressures to 100 psi and has capacity of 0.33 to 12.5 gpm. Electrically rated for motor duty at 115 v ac, 12.5 amp. Main contacts are normally closed, SPST. Individual units are $20.74 list, FOB Pine Hall. **Payne Engineering Co, Pine Hall, NC.**

Circle 101, Reader Service Card



Transistor-equipped static control module . . .

with no moving parts can be incorporated into control system that duplicates functions of machine tool, stepping or latching relays and timers. Major components of system, which utilizes about ¼ of conventional relay panel space, are power supply (to convert 115 v 60 cps ac to dc power for inputs and logic elements); signal converters (to provide proper signal power from pilot devices to logic elements); logic elements (to perform control functions); and output amplifiers (to raise outputs of logic elements to required levels for use with solenoids, contactors and starters and to deliver power to output devices). Logic functions, such as AND, OR, NOT and MEMORY, can be accomplished by combinations of basic transistor-equipped NOR module, capable of switching rates up to 25,000 times per sec. Logic elements list at $40 for retentive memory unit; $48 for unit of 2 time-delay elements; $44 for unit of 7 2-input diodes and 7 1-input bypass diodes; $56 for unit combining 6 standard or power NOR modules and $168 for unit with 20 NOR modules. Prices for power supplies, inputs, output amplifiers, or other control system components are dependent upon function. **Square D Co, 4041 N Richards St, Milwaukee 12.**

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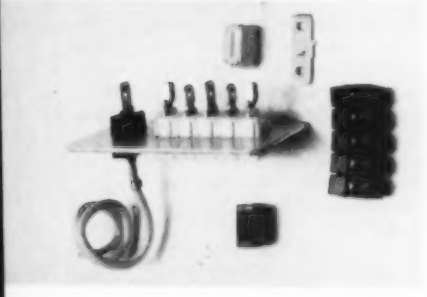


Miniature bushings . . .

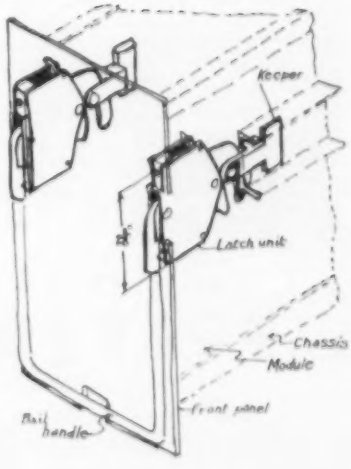
are nylon-insulated, junction-terminal receptacles that mate with ⅛ and ¼-in. standard female disconnect wire terminals. Provide quick-disconnect access through housings and are color- and number-coded. Available as singles or flexibly-connected units to max of five, which fit into and conform to curved or flat surfaces. In quantities of 100 to 10,000, individual bushings are $1.50 per 100. **Heyman Mfg Co, Kenilworth, NJ.**

Circle 102, Reader Service Card

Modular latch assembly . . .

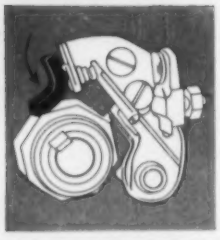
locks or ejects rack-mounted modular unit with single motion of actuating lever and, at same time, completes or breaks electrical circuit. Latches may be linked by bail handle for simultaneous action on both sides of module. ⅛-in. min travel is said to provide 10:1 ratio of hand force to pin injection. Resists motion in three major directions and 1000-lb pull-out force per pair. Locking and unlocking action is through 90° of handle motion. Mounts flush in ½ in. wide min. Adaptable to any size module, latch is for panels up to 0.135 in. thick. Assembly consists of latch (attached to module panel) and keeper (attached to frame). All-steel latches weigh about 0.35 lb each. **Souther Chester Corp, Lester, Penna.**

Circle 103, Reader Service Card

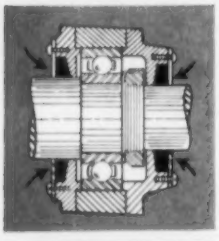


How
FELT
BY FELTERS
Can Improve Product
SEALING and LUBRICATION

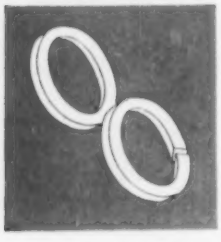
DuFelt is a laminated combination of Felters' felt and Hycar; and is recommended for sealing of lighter oils when no head exists. Seals and lubricates at the same time; and offers improvements over other materials.



Felt is an ideal wicking and lubricating material which can be designed into special assemblies like this distributor cam shown here. Lubrication is constant, wear reduced, and felt can be shaped to cover all required areas.



Lifetime bearing lubrication is now possible by selection of correct SAE grade, and designing into sealed bearing. Felt filters out contamination and works as combined reservoir and wick, directing oil flow to required areas.



Mechanical felt seals permit a close seal without undue pressure. Felt can be waterproofed and provides superior grease and oil retaining and dust, dirt and grit exclusion.

To help you get the most out of FELT, send for the Felters' Design Book. Write, today.

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Pioneer Producers of Felt and Synthetic Non-Woven Fabrics

FE 9-18

SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .

Adhesives for polystyrene . . . are for joining foamed-in-place or prefoamed polystyrene with steel, aluminum, masonite, wood and other materials, as well as polystyrene itself. A-827-B, used properly with foamed-in-place polystyrene, withstands repeated simulated weather cycles involving immersion in water at 120 F, hot-water spray at 160 F, dry-air heat at 160 F, and storage at —40 F. R-1083-T, used with prefoamed polystyrene, is said to eliminate noticeable stress crazing, which weakens polystyrene by collapsing foam. Bonds withstand simulated weathering cycles involving temperatures of 160 to —40 F plus water immersion and salt spray environment. Pint samples may be obtained for $2. **B F Goodrich Industrial Products Co, Adhesives Div, 500 S Main St, Akron 18.**

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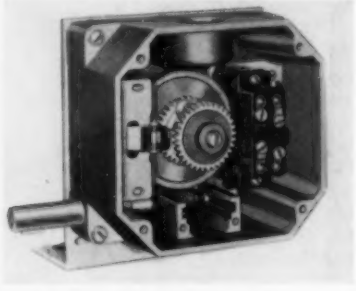


Rotating-shaft limit switch . . . is rated for 600 v max and can be used as pilot device for controlling ac or dc reversing starters or contactors that operate motors on machine tools, cranes, valves and other similar forward-reverse operations. Six gear ratios, from 40:1 to 1080:1, when mechanically coupled to driving equipment, eliminate need for two to four remotely located conventional limit switches. Limits are set by turning screw. **Cutler-Hammer Inc, 315 N 12th St, Milwaukee 1.**

Circle 106, Reader Service Card

Miniature linear actuator . . . incorporates slip clutch to eliminate limit switches and protect against excessive loads. Various combinations of speeds and strokes handle loads up to 400 lb. Envelope is $1\frac{3}{8}$ x 3 x $5\frac{3}{4}$ in. long and unit weighs about 1 lb. Flat-side housing, a one-piece extrusion, is said to be readily adaptable to gear ratio changes and addition of components required by specific applications. Choice of motor positions is available. **Lear Inc, PO Box 688, Grand Rapids 2, Mich.**

Circle 107, Reader Service Card

Barden Precision SFRI-5 miniature bearings as used in a computer gear train.

Specify **BARDEN** *Precision miniature ball bearings*

Precision-built computer gear trains must have uniformly low torque and minimum backlash; mounting surfaces for the bearings should be simple to manufacture.

Barden Precision miniature-size bearings have the required low torque. Their low eccentricity and closely controlled radial play assure minimum backlash. Precision flanges provide accurate positioning surfaces and permit through-boring, eliminating the need for housing shoulders.

Barden Precision miniature bearings are built to the same high standards of consistent quality as Barden's larger instrument sizes.

Barden Precision means not only dimensional accuracy but performance to match the demands of the application.

Your product needs *Barden Precision* if it has critical requirements for accuracy, torque, vibration, temperature, or high speed. For less difficult applications, the *predictable* performance of *Barden Precision* bearings can cut your rejection rates and teardown costs.

Write today for your copy of Catalog Supplement M1 which gives dimensions, performance and engineering data on *Barden Precision* ball bearings 5/8" O.D. and smaller.

THE BARDEN CORPORATION

77 E. Franklin St., Danbury, Connecticut • Western office: 3850 Wilshire Blvd., Los Angeles 5, California

SPECIFY BARDEN PRECISION BALL BEARINGS FOR: INSTRUMENTS • AIRCRAFT ACCESSORIES • COMPUTERS AND RECORDERS • MACHINE TOOL AND TEXTILE SPINDLES • OTHER PRECISION APPLICATIONS

WELD TYPE FITTINGS for use with Anchor Flanco Couplings

These new fittings provide greater flexibility for the fabrication of hydraulic transmission lines made from pipe or tubing, and more convenience in assembly to a hydraulic circuit. Pipe threads and pipe fittings, with all their inherent piping problems, can be eliminated, and pipe or tubing assemblies with better flow characteristics are produced.

Four socket-head screws are used to bolt these new forged steel, weld type fittings to valve or pump bodies. Anchor FLANCO SAE 4-Bolt, Split-Flange Clamp Halves and "O" Ring Flanged Head Couplings are used to connect flexible hydraulic hose to pipe or tubing assemblies.

Anchor's new weld type fittings are designed in straight, 90° elbow and tee styles for pipe ends, and in saddle style for welding onto pipe or tubing between ends. With these weld type fittings, pipe or tube assemblies of any shape for any number of openings can be produced. Standard weld type fittings are suitable for working pressures up to 3000 psi.

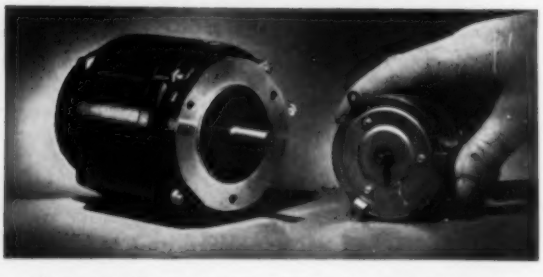
Andy Anchor says: For complete details and specifications on my new Weld Type Fittings write for Supplement to Catalog 402 today

ANCHOR COUPLING CO. INC.
313 No. Fourth St., Libertyville, Ill.
Branch Plants: Dallas, Texas; Plymouth, Mich.

CIRCLE NO. 80 READER SERVICE CARD

GEARLESS, HIGH-TORQUE, REVERSIBLE

75-RPM and 100-RPM SYNCHRONOUS MOTORS

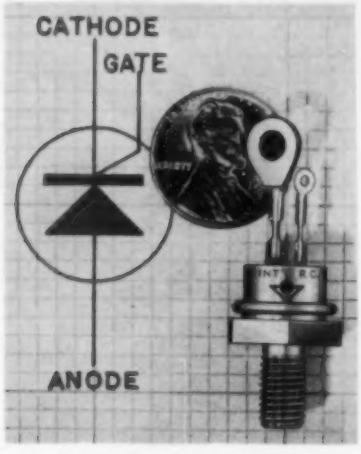


These amazing gearless motors develop up to 75 oz.-in. torque, feature instantaneous acceleration to synchronous speed within ½ cycle, and have extremely high torque for synchronous motors of this size. Can be reversed instantly. These motors—with lubricated-for-life bearings—withstand continuous duty or stalling with only 40C rise.

FREE BULLETIN! Ask for GEC-1294B. Write to Section 633-5, General Electric Co., Schenectady, N. Y.

GENERAL ELECTRIC

SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .



Miniature rectifier . . . combines some characteristics of rectifier and a power transistor. Currently available for applications requiring blocking voltages of 20, 30, 50, 70, 100, 150 or 200 v and load currents up to 10 amp. Leakage currents, forward and reverse, are about 12 milliamp. Three-junction semiconductor component switches, in microsec, to conducting state when signal is applied to gate terminal or when critical forward breakover voltage is exceeded. After switching, silicon-controlled rectifier exhibits forward voltage drop of about 1.5 v at 77 F, comparable to single-junction rectifier. Control properties enable unit to perform many of functions of thyratron, power transistor, magnetic amplifier and related units that control power to a load proportionately from ac source. Operates to 212 F. Units are hermetically sealed and have over-all height of 1.625 in. $20 to $65 each. Delivery, 6 to 8 wk. **International Rectifier Corp, 1521 E Grand Ave, El Segundo, Calif.**

Circle 108, Reader Service Card

Digital projection unit . . . has a condensing lens which contains 12 different digits. When any one of 12 lamps at rear of unit lights, corresponding character or digit is projected through projection lens onto 1½ x 2-in. viewing

screen. Over-all size of complete unit is $1\frac{7}{16}$ x $2\frac{3}{8}$ x $5\frac{1}{8}$ in.; voltage to operate is 6 to 7.5 v ac. Price of single unit is $15.50. **Industrial Electronic Engineers Inc, 3973 Lankershim Blvd, N Hollywood, Calif.**

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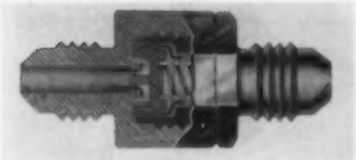

Automatic air duct valve . . .

drains water condensate and residual fuels whenever system loses pressure. Stays fully open, draining air duct, for pressures up to $\frac{1}{2}$ psi above drain pressures. Stays fully closed for duct-to-drain differentials above $1\frac{1}{2}$ psi. There are no recesses where water condensate could freeze. Built for $\frac{1}{4}$-in. line size, but can be scaled to others. Designed for air, valve can be modified to handle any fluid. Operates in −65 to 675 F at operating pressures to 150 psi and drains $\frac{1}{2}$ gpm at $\frac{1}{2}$ psi. Weighs 0.1 lb. **Aero Supply Mfg Co, Corry, Penna.**

Circle 110, Reader Service Card

Switching commutator . . .

in miniature, lightweight model is said to offer low noise, low torque, long life and angular accuracy of 10 min. of arc. Motor driven or hand detented units available. Reported to be suitable for programming, selecting, high-speed sampling, synchronous drives, multipole and multithrow switches and sinusoidal switches. **Airflyte Electronics Co, 535 Ave A, Bayonne, NJ.**

Circle 111, Reader Service Card

Angle-measuring system . . .

provides continuous decimal display in degrees and thousandths of degrees. Output is in decimal and 8-4-2-1 binary-coded decimal form—or an in-line decimal display is also available. Vernier signals are also provided by two tone-generators in transducer, one of which is attached to input shaft. Phase shift between two signals is continuously measured. **Colorado Research Corp, Bloomfield, Colo.**

Circle 112, Reader Service Card

Precise-angle indicators . . .

for rack-panel mounting are complete servo systems for numerical presentation of angular positions. Consist of indicator, motor and servo amplifier. System repeats within 0.6 min., clockwise or counter-clockwise, for any angular position. Readibility is 0.5 min. through full range, with reported accuracy of 6 min.; sensitivity of 0.5 min. Operates on 115 v, single phase, 400 cps, 23 volt-amp max. **Kearfott Co, 1500 Main Ave, Clifton, NJ.**

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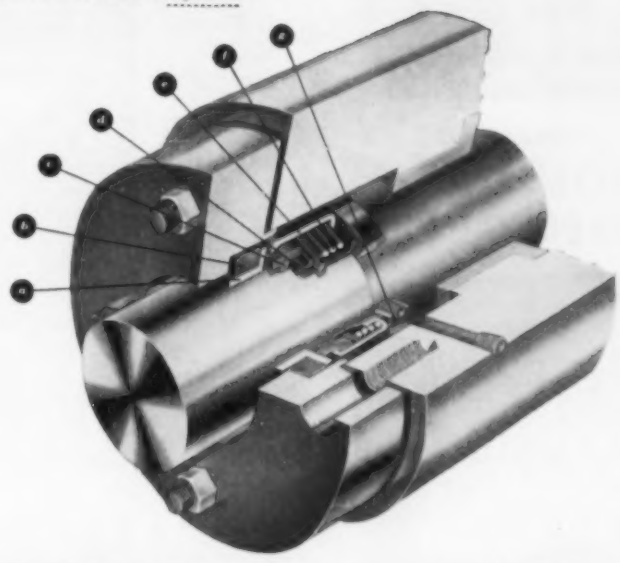
ONE OF THE GARLOCK **2,000**



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f. ***Stainless Steel Spring*** *with load precisely calculated to face area of seal.*

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Casting alloy for 500 F . . . service and higher is said to retain good mechanical properties through 800 F. May be die-cast in regular equipment with minimum changes from standard procedure and is offered with most finishes currently used on magnesium. Alloy contains about 1% thorium, 1% manganese and has magnesium base. Density is 0.064 lb per cu in. Separately die-cast test bars are reported to exhibit average tensile strengths of 30,200 psi at 70 F, 16,800 psi at 400 F, 12,400 psi at 600 F and 7800 psi at 800 F. Dow Chemical Co, Midland, Mich.

Circle 114, Reader Service Card

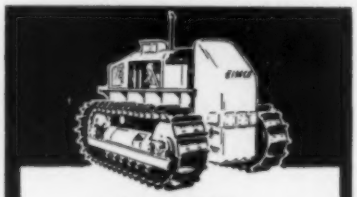
Caster-mount absorbs shock . . . and protects sensitive components during handling operations and in transit. Two sizes, for use with 6 and 4-in.-dia caster wheels, each handle 400-lb static load. For 8-in. flat drop, mount is said to transmit 10 g max with rated static load. Natural frequency at rated static load is about 7 cps. High damping characteristics of stainless steel resilient cushions reduce excursion at resonance and minimize rebound after drop impact. Nonlinear spring rate results in substantial overload capacity. Robinson Technical Products Inc, Teterboro Air Terminal, Teterboro, NJ.

Circle 115, Reader Service Card

High-strength casting alloy . . . is highly responsive to heat treatment, which can be controlled to emphasize specific physical properties. Obtained by varying chemical composition of conventional aluminum alloy, this high-purity material is said to achieve weight-saving efficiencies in sand and permanent mold castings. Missile castings are reported to regularly exceed physical specifications of MIL-C-21180A. In T-6 condition, ultimate tensile strength can be controlled within 40,000 to 50,000 psi; yield strength within 30,000 and 40,000 psi; elongation within 2 to 5%. Rolle Mfg Co, 3rd and Cannon Aves, Lansdale, Penna.

Circle 116, Reader Service Card

EMPLOYMENT OPPORTUNITIES



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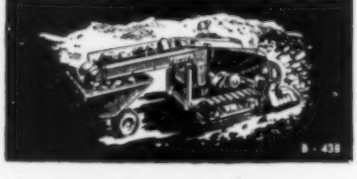

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NEW LITERATURE

Collective Bargaining as Viewed by Unorganized Engineers and Scientists

JOHN W RIEGEL, Professor of Industrial Relations, University of Michigan. Publications Distribution Service, University of Michigan, Ann Arbor, Mich. 6 x 9, 103 pp. $4.

This third report in a series concerning management relations with engineers and scientists is based on responses of 264 nonsupervisory interviewees. It includes a dozen tables, of which the second is the most interesting. It shows that 50% are strongly against collective bargaining, another 23% are mildly anti, with 2½% mildly and 5% strongly "pro."

Study of the text details opinions of all categories on various aspects of the question, thus provides perspective on the answers. Again and again, the strengthening professional feeling of the engineers is evident, and Table II shows some 8% in favor of professional-society action. They did not, however, want their societies to change, except to police more vigorously the requirements for professional status, and to provide the information to be presented to employers. There is some feeling for the equivalent of the American Medical Assn in engineering, but by far the strongest feeling is that the individual will take his own chances with his employer. He doesn't want seniority or collective provisions that challenge his individual professional status. EJT

The Atlantic Cable

BERN DIBNER. Burndy Library, Norwalk, Conn. 8½ x 11, 96 pp. $3.50 (in cloth); $2.50 (in paper).

From Cyrus Field's concept that an intercontinental telephone cable was feasible, to the actual headaches involved in attempting to lay this cable, there were problems to surmount and myriads of people to convince. *The Atlantic Cable* is not so much a story of the personal triumph of Field as it is a step-by-step engineering task that had to be accomplished. Incorporated are reproductions of the original maps, illustrations from the journals of the day, plus an excellent array of well-documented technical drawings. Just as the submarine cable itself was needed to communicate between nations, Dibner's *The Atlantic Cable* is a long-needed commentary on how this monumental task was accomplished. —BAL

Instrument Construction

This is the USSR monthly journal *Priborostroenie* which, beginning with the Jan '59 issue, is being published in translation by Taylor & Francis Ltd, Red Lion Court, Fleet St, London E C 4, England. The first issue contains articles on automation; instrument theory, calculation and construction; new experimental work in the USSR. Yearly subscription costs $17.10. Published 2 to 3 mo after date appearing on cover.

TORQUE CALCULATOR—Designed to determine torque in flexible shafting applications, but usable for all torque determinations. Available free. Stow Mfg Co, Binghamton, NY.

Circle 122, Reader Service Card

FILMS FROM PLASTICS INDUSTRY—Catalog, 28 pp. Latest edition contains many new motion picture films, film strips and slide sets, increasing size one-third over last bulletin. Films are briefly described and their supply source given. Society of Plastics Industry Inc, 250 Park Ave, New York 17.

Circle 123, Reader Service Card

CHOOSING AN OFFICE COPY-MACHINE—Bulletin, 6 pp. Describes main features of six different photocopy processes and makes recommendations for specific copying problems. Peerless Photo Products Inc, Shoreham, NY.

Circle 124, Reader Service Card

MAGNESIUM APPLICATIONS IN AIRCRAFT—Brochure, 28 pp. Physical and mechanical properties of magnesium castings, sheet and extrusions that are advantageous in airframe design. Gives numerous case histories. Dow Chemical Co, Midland, Mich.

Circle 125, Reader Service Card

MINIATURE CONNECTORS—Catalog sheets (28) in folder. Specifications, application information, general features and dimensional drawings for series of floating body isolation miniature connectors. US Components Inc, 454 E 148th St, New York 55.

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Publisher's Postscript...

WALKING the KNIFE EDGE

Al Hauptli (AH) has set quite a pace in this department since its inception. He has kept you posted on our plans and efforts to provide a most-readable publication. I hope to be able to do as well.

This matter of readability goes deep. For the past twenty years, I have heard, periodically, some critic of technical magazines say they are "stuffy" or "stodgy." Some of this comment is of course generated by the fact that the self-styled expert can't understand any part of the content, so attempts to cover his embarrassment by implying that it is the magazine which is at fault. But some of the comment is justified when technical magazines are compared with general magazines or newspapers, which emphasize the sensational elements of day-to-day development. It makes for interesting appearance. But such treatment may push the actual facts around a bit to get the desired result, or the writer may have insufficient knowledge of the subject, so his interpretation is at fault. This the technical magazine cannot and must not do.

In any case, we think we have belied both "stuffy" and "stodgy" in our recent changes in *Product Engineering*. We have striven to provide a highly readable magazine while sticking strictly to the factual and important engineering information of the day. We've also worked to simplify and streamline our technical articles without removing any of their technical content.

This, of course, leads to another critical adjective on occasion —"superficial." This is, of course, ridiculous. Our technical content is far greater than it was two years ago, both because we have more pages and because the individual article is more concentrated. Our authors are a Who's Who in design engineering. We also have almost twice as many editors at work, plus our booklet on "How to Write for Product Engineering." (If you want a copy, ask for it on the postcard on the facing page.)

In any case, it is our intention to maintain a magazine that is not stodgy or stuffy on the one hand, nor superficial on the other. This, we know, requires continual diligence. And this is an essential part of my job. Your opinion or suggestions will be appreciated at any time.

—SJA

For Your Information (personal)

Vacuum your pool, sir?

Testimony to growing importance of the swimming-pool market is this designed-for-the-job vacuum cleaner. It's water-operated (by an ordinary garden hose), comes equipped with brush or wheels, is priced at $19.95. Tenite-butyrate plastic is used for the housing, which accommodates a standard filter bag and a 1¼-in.-OD aluminum handle.

Incidentally, if you're readying your own backyard bathtub for summer use, you may want "Health Hints for Backyard Pools." The leaflet is free (for a self-addressed, stamped envelope) from Living Products Co, 200 Fifth Ave, New York 10.

Drawing with foil

Want to simplify drafting-room practice? Borrow a roll of foil from your wife's kitchen, a sheet of blue-anodized material from the shop, then try these ideas:

In the Styling Div of one major auto company, aluminum foil serves as drafting paper for master drawings of body sections, the drawings being made directly on the foil. The reason: metal won't shrink or expand with changes in humidity, can maintain an accuracy of 0.001 in. on large drawings for long periods of time.

In the drafting room of an engineering firm, blue-anodized sheet, permanently scribed with reference lines, is used to surface drafting tables. Draftsmen say the sheet forms a good working surface, and the lines show clearly through tracing paper.

Fair warning for motorists

Nobody, perhaps, can stop the Hell-bent-for-extinction driver who insists on exceeding the speed limit or driving on the wrong side of the road, but two developments may help some by warning the driver who wants to be careful.

From H D Howden Ltd of England, comes news of an automatic light indicator, designed to tell the driver if and when his side, tail, or headlights fail. It's a tiny device (about 3½ x 1½ x 2½ in.) that consists of a relay to be incorporated in the lighting circuit, two indicators (one green and one red) and a length of wire. The red light, of course, indicates failure, and the unit can be so arranged that alternate flashing red and green will signal any intermittent fault in the wiring. Price (fob Glasgow) is about $9.50.

Meanwhile, auto companies in this country are working on everything from a low-frequency radio system that will broadcast warnings through a car's radio to an "automatic highway" that will take over just about the whole driving job.

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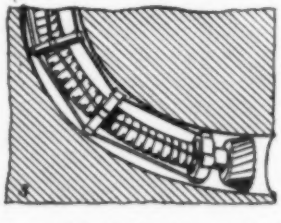
Why Don't They

R and D

RESEARCH AND DEVELOP . . .

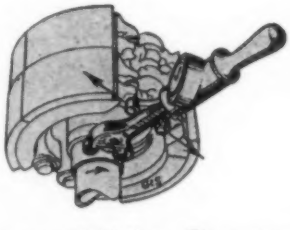
. . . a flowmeter for the milk processing industry. Two restrictions rule out most available measuring instruments that might otherwise be used to measure flow of milk in a pipe: they must be accurate, must be easy to clean. A constant-displacement volume flowmeter of the wobble plate variety has too many moving parts and is too difficult to clean. Velocity-flow meters, which sense changes in pressure across a venturi or measure speed of sound waves through the moving fluid, are too inaccurate. A simple constant-displacement meter or a more accurate, passive velocity-measuring device is required. Must be made from materials that can withstand high sterilization temperatures and will not contaminate the milk when in use.

—R A Neilson



. . . a drill or drilling machine that will make curved holes. Curved passages for hydraulic and pneumatic systems would be more efficient than rectilinear passages because of reduced frictional losses, lack of cavitation, surges. And designers could specify curved holes in castings without intricate cores. Might also be used for drilling oil holes in crankshafts, holes in carburetor bodies, etc. Device should be capable of making curved holes of constant radius as well as holes that make a turn after a short straight section. Could utilize flexible shafting and externally controlled drill point. Other possibilities are ultrasonics or particle bombardment constrained and directed by flexible tubing.

—G D Pheil



. . . a portable, inexpensive automobile dynamometer suitable for small tune-up shops and service stations. An accelerometer mounted on the car can be calibrated to give horsepower readings (if weight of the car and engine rpm are known) but will not make allowances for inclined roads, air drag, or road friction. Dynamometers for measuring power when the automobile is stationary require large flywheels, water brakes, generators to absorb the energy. Perhaps a recording dynamometer could be made which would use the automobile's rear brakes to absorb the energy for very short periods of time (long enough to get a torque-rpm curve).

—R Preston

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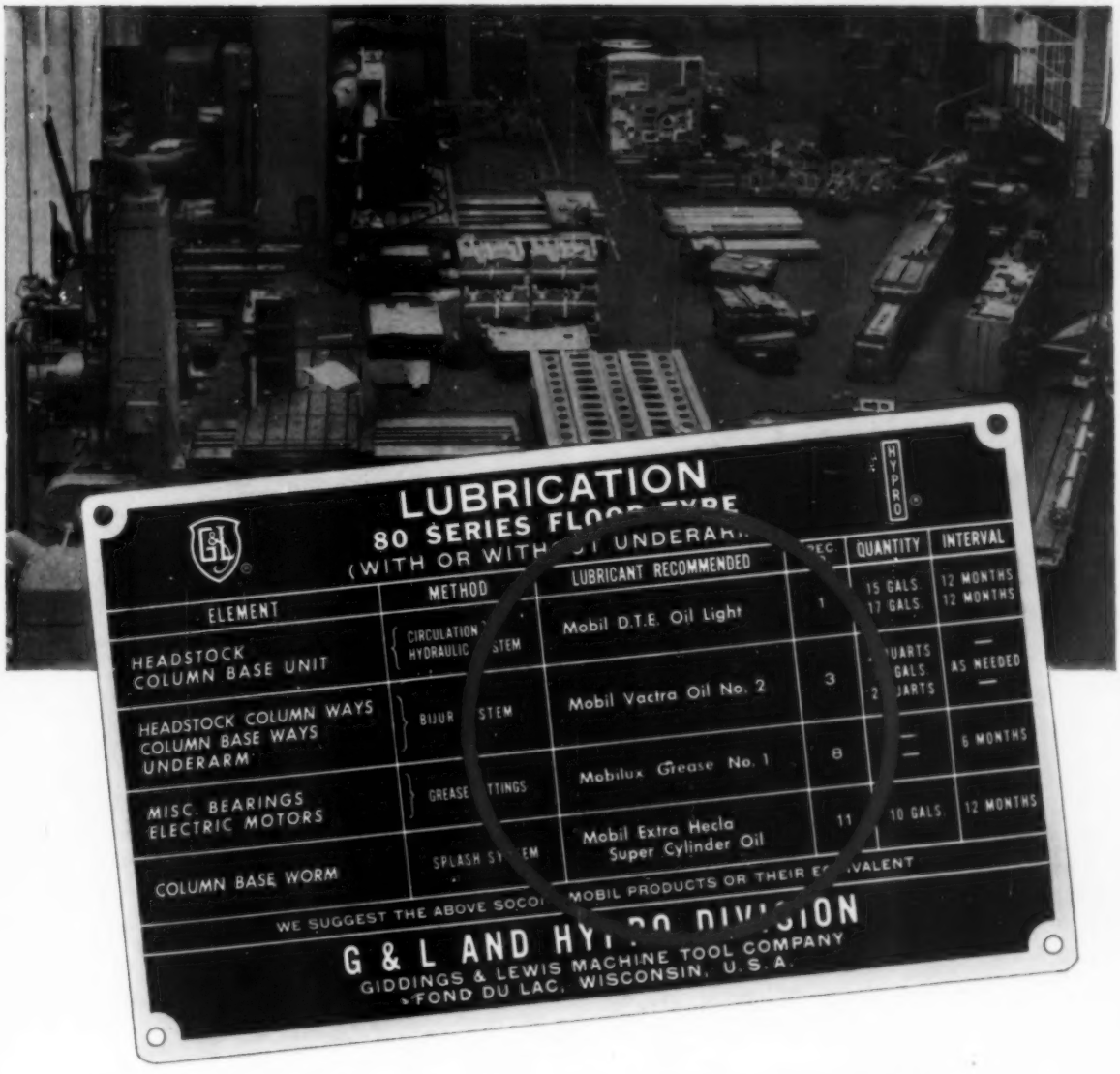

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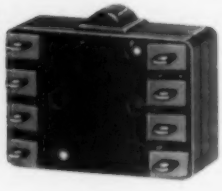
four circuit? HERE THEY ARE...

double pole

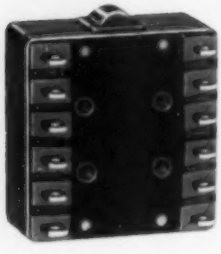


actual size

D series
DPDT, 4 CKT.
L.W.H. 1¼" x ½" x ⅜"
Elec. Rating: 15 amps @ 125/250 V.A.C.
15 amps Res. @ 30 V.D.C.
10 amps Ind. @ 30 V.D.C.
Operating Force 23 to 33 oz.
Amb. Temp. −100 to +375° F.
Termination D4 series—end solder
D8 series—side solder
Available in simultaneous, non-simultaneous and reset models. Models available with Military and U.L. approval. Write for details.

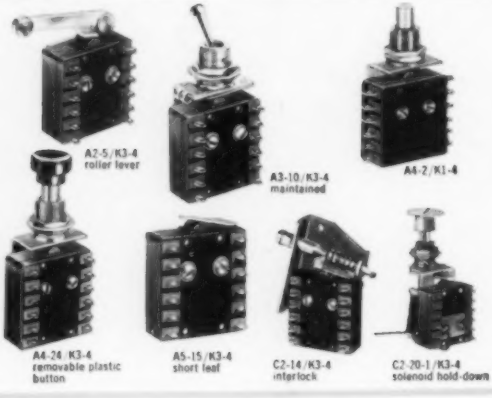
six circuit? THESE TOO...

triple pole



actual size

K series
TPDT, 6 CKT.
L.W.H. 1¼" x .491" x 1-5/16"
Elec. Rating: 15 amps @ 125/250 V.A.C.
15 amps Res. @ 30 V.D.C.
10 amps Ind. @ 30 V.D.C.
Operating Force 40 oz.
Amb. Temp. −100° to +375° F.
Termination K1 series—end solder
K3 series—side solder
Available in simultaneous, non-simultaneous and reset models. Models available with Military and U.L. approval. Write for details.



eight circuit? YES...

multi-pole combination actuator assemblies

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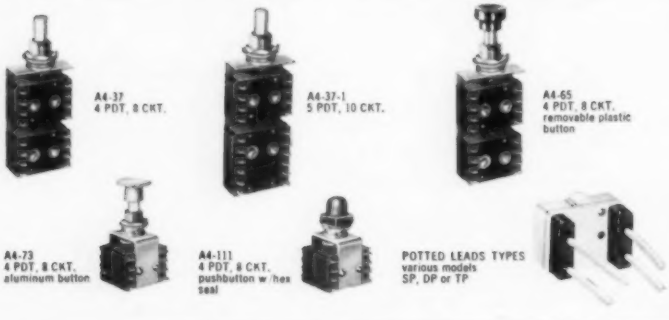
A4-37 4 PDT, 8 CKT.
A4-37-1 5 PDT, 10 CKT.
A4-65 4 PDT, 8 CKT. removable plastic button
A4-73 4 PDT, 8 CKT. aluminum button
A4-111 4 PDT, 8 CKT. pushbutton w/hex seal
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